ACSM1

Firmware Manual
ACSM1 Speed and Torque Control Program

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Firmware Manual

3AFE68848261 REV D
EN
EFFECTIVE: 12.11.2007

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Introduction to the manual

What this chapter contains

The chapter includes a description of the contents of the manual. In addition it contains information about the compatibility, safety and intended audience.

Compatibility

The manual is compatible with ACSM1 Speed and Torque Control program version UMFI 1210 and later versions. See signal *9.04* FIRMWARE VER or PC tool (View - Properties).

Safety instructions

Follow all safety instructions delivered with the drive.

• Read the **complete safety instructions** before you install, commission, or use the drive. The complete safety instructions are given at the beginning of the Hardware Manual.

• Read the **software function specific warnings and notes** before changing the default settings of the function. For each function, the warnings and notes are given in this manual in the section describing the related user-adjustable parameters.

Reader

The reader of the manual is expected to know the standard electrical wiring practices, electronic components, and electrical schematic symbols.

Contents

The manual consists of the following chapters:

- *Start-up* instructs in setting up the Speed and Torque Control program and how to control the drive through the I/O interface.
- *Drive programming via PC tool* introduces programming via PC tool (DriveStudio and Solution Program Composer).
- *Control locations and operating modes* describes the control locations and operation modes of the drive.
- *Default connections of the control unit* presents the default connections of the JCU Control Unit.
- *Firmware functions, parameters and signals* describes the firmware function blocks and the associated input parameters and output signals.
- *Parameter and signal data* contains more information on the input parameters and output signals of the firmware blocks.
- *Fault tracing* lists the warning and fault messages with the possible causes and remedies.
- *Standard function blocks*
- *Control block diagrams*

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type code and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/drives and selecting *Drives – Sales, Support and Service network*.

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Drives – Training courses*.

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Your comments on our manuals are welcome. Go to www.abb.com/drives and select *Document Library – Manuals feedback form (LV AC drives)*.

Start-up

What this chapter contains

This chapter describes the basic start-up procedure of the drive and instructs in how to control the drive through the I/O interface.

How to start up the drive

The drive can be operated:

- locally from PC tool or control panel
- externally via I/O connections or fieldbus interface.

The start-up procedure presented uses the DriveStudio PC tool program. Drive references and signals can be monitored with DriveStudio (Data Logger or Monitor Window). For instructions on how to use the DriveStudio, see *DriveStudio User Manual* [3AFE68749026 (English)].

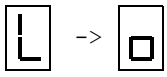
The start-up procedure includes actions which need to be performed only when the drive is powered up for the first time (e.g. entering the motor data). After the first start-up, the drive can be powered up without using these start-up functions. The start-up procedure can be repeated later if start-up data needs to be changed.

In addition to the PC tool commissioning and drive power-up, the start-up procedure includes the following steps:

- entering the motor data and performing the motor identification run
- setting up the encoder/resolver communication
- checking the emergency stop and Safe Torque Off circuits
- setting up the voltage control
- setting the drive limits
- setting up the motor overtemperature protection
- tuning the speed controller
- setting up the fieldbus control.

If an alarm or a fault is generated during the start-up, see chapter Fault tracing for the possible causes and remedies. If problems continue, disconnect the main power and wait 5 minutes for the intermediate circuit capacitors to discharge and check the drive and motor connections.

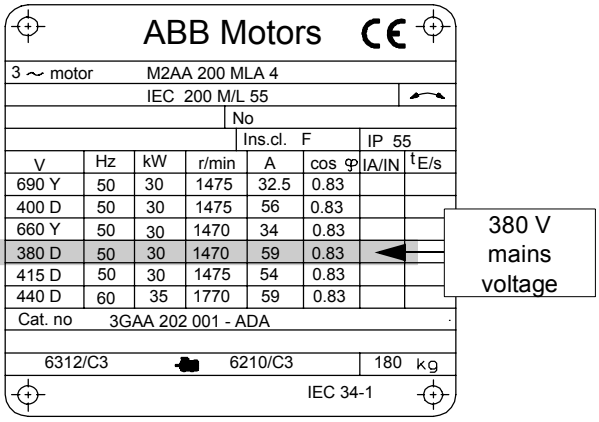
Before you start, ensure you have the motor nameplate and encoder data (if needed) at your hand.

Safety		
	The start-up may only be carried out by a qualified electrician. The safety instructions must be followed during the start-up procedure. See the safety instructions on the first pages of the appropriate hardware manual.	
☐	Check the installation. See the installation checklist in the appropriate hardware manual.	
☐	Check that the starting of the motor does not cause any danger. **De-couple the driven machine** if - there is a risk of damage in case of an incorrect direction of rotation, or - a normal ID run (99.13 = NORMAL) is required during the drive start-up, when the load torque is higher than 20% or the machinery is not able to withstand the nominal torque transient during the ID run.	
PC tool		
☐	Install the DriveStudio PC tool to the PC. For instruction, see *DriveStudio User Manual* [3AFE68749026 (English)].	
☐	Connect the drive to the PC: Connect the other end of the communication cable (OPCA-02, code: 68239745) to the panel link of the drive. Connect the other end of the communication cable via USB adapter or directly to the PC serial port.	
Power up		
☐	Switch the power on.	7-segment display: 
☐	Start the DriveStudio program by clicking the DriveStudio icon on the PC desktop.	 DriveStudio.exe
☐	Check whether a solution program exists. Select Solution Program Composer from the DriveStudio View-menu. If a solution program already exists, NOTE that some of the drive functions may have been disabled. ENSURE, that the solution program is suitable for your drive application.	
☐	Switch to local control to ensure that external control is disabled by clicking the Take/Release button of the PC tool control panel.	

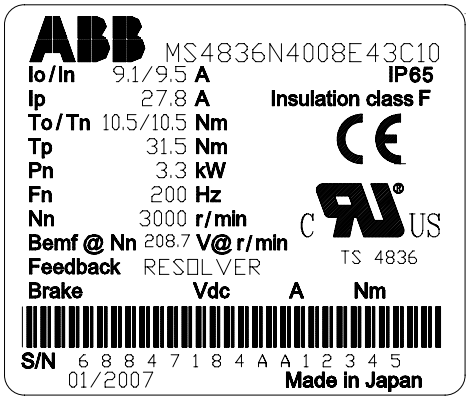
Motor data entering		
☐	Open the parameter and signal list by selecting the Parameter Browser of the appropriate drive.	
☐	Select the language. **Note:** Language selection is not supported yet. Only English is available. Parameters are set as follows: Select the parameter group (in this case 99 START-UP DATA) by double-clicking it. Select the appropriate parameter by double-clicking it and set the new value.	99.01 LANGUAGE
Motor data can be entered either by selecting a specific motor catalogue by parameter 99.02 MOTOR CATALOGUE or manually by setting motor parameters 99.04…99.12.		
Motor data from catalogue		
Note: Motor catalogue feature is not supported yet.		
☐	Select the appropriate motor catalogue.	99.02 MOTOR CATALOGUE
☐	Select the appropriate motor.	99.03 MOTOR SELECTION
Manual motor data entering		
☐	Select the motor type: asynchronous or permanent magnet motor.	99.04 MOTOR TYPE
☐	Select the motor control mode. DTC is suitable for most cases. For information on scalar control, see parameter 99.05 MOTOR CTRL MODE description. **Note:** Control mode selection is not supported yet. Direct Torque Control is always used.	99.05 MOTOR CTRL MODE

☐ Enter the motor data from the motor nameplate.

Asynchronous motor nameplate example:



Permanent magnet motor nameplate example:



With DTC control (99.05 = DTC) at least parameters 99.06…99.10 must be set. Better control accuracy can be achieved by setting also parameters 99.11…99.12.

- motor nominal current

Allowed range: approximately 1/6 · I_{2n} … 2 · I_{2n} of the drive (0…2 · I_{2nd} if parameter 99.05 MOTOR CTRL MODE = SCALAR). With multimotor drives, see section Multimotor drives on page 19.

99.06 MOT NOM CURRENT

- motor nominal voltage

Allowed range: 1/6 · U_N … 2 · U_N of the drive. (U_N refers to the highest voltage in each of the nominal voltage range, i.e. 480 V AC for ACSM1-04).

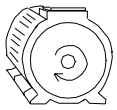
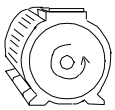
With permanent magnet motors: The nominal voltage is the BackEMF voltage (at motor nominal speed). If the voltage is given as voltage per rpm, e.g. 60 V per 1000 rpm, the voltage for 3000 rpm nominal speed is 3 × 60 V = 180 V.

Note that the nominal voltage is not equal to the equivalent DC motor voltage (E.D.C.M.) value given by some motor manufactures. The nominal voltage can be calculated by dividing the E.D.C.M. voltage by 1.7 (= square root of 3).

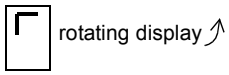
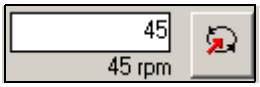
99.07 MOT NOM VOLTAGE

Note: Set the motor data to exactly the same value as on the motor nameplate. For example, if the motor nominal speed is 1470 rpm on the nameplate, setting the value of parameter 99.09 MOT NOM SPEED to 1500 rpm results in wrong operation of the drive.

	- motor nominal frequency Range: 5…500 Hz. With multimotor drives, see section Multimotor drives on page 19. With permanent magnet motor: If the frequency is not given on the motor nameplate, it has to be calculated with the following formula: $f = n \times p / 60$ where p = number of pole pairs, n = motor nominal speed.	99.08 MOT NOM FREQ
	- motor nominal speed Range: 0…10000 rpm. With multimotor drives, see section Multimotor drives on page 19.	99.09 MOT NOM SPEED
	- motor nominal power Range: 0…10000 kW. With multimotor drives, see section Multimotor drives on page 19.	99.10 MOT NOM POWER
	- motor nominal cosφ (not applicable for permanent magnet motors). This value can be set for better DTC control accuracy. If value is not given by the motor manufacturer, use value 0 (i.e. default value). Range: 0…1.	99.11 MOT NOM COSFII
	- motor nominal shaft torque. This value can be set for better DTC control accuracy. If value is not given by the motor manufacturer, use value 0 (i.e. default value). Range: 0…2147483.647 Nm.	99.12 MOT NOM TORQUE
☐	After the motor parameters have been set, alarm ID-RUN is generated to inform that the ID run needs to be performed.	Alarm: ID-RUN
	Multimotor drives **I.e. more than one motor is connected to one drive.**	
☐	Check that the motors have the same relative slip (only for asynchronous motors), nominal voltage and number of poles. If the manufacturer motor data is insufficient, use the following formulas to calculate the slip and the number of poles: $p = \mathrm{Int}\left(\frac{f_N \cdot 60}{n_N}\right)$ $n_s = \frac{f_N \cdot 60}{p}$ $s = \frac{n_S - n_N}{n_S} \cdot 100\%$ where p = number of pole pairs (= motor pole number / 2) f_N = motor nominal frequency [Hz] n_N = motor nominal speed [rpm] s = motor slip [%] n_S = motor synchronous speed [rpm].	

☐	Set the sum of the motor nominal currents.	99.06 MOT NOM CURRENT
☐	Set the nominal motor frequencies. Frequencies must be the same.	99.08 MOT NOM FREQ
☐	Set the sum of the motor nominal powers. If the motor powers are close to each other or the same but the nominal speeds vary slightly, parameter 99.09 MOT NOM SPEED can be set to an average value of the motor speeds.	99.10 MOT NOM POWER 99.09 MOT NOM SPEED
Motor overtemperature protection (1)		
☐	Select how the drive reacts when motor overtemperature is detected.	45.01 MOT TEMP PROT
☐	Select the motor temperature protection: motor thermal model or motor temperature measurement. For motor temperature measurement connections, see section Temperature sensors on page 127.	45.02 MOT TEMP SOURCE
ID RUN (motor identification run)		
	WARNING! With Normal or Reduced ID run the motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	
Note: Ensure that possible Safe Torque Off and emergency stop circuits are closed during the ID run.		
☐	Check the direction of rotation of the motor before starting the ID run. During the run (Normal or Reduced), the motor will rotate in the forward direction.	When drive output phases U2, V2 and W2 are connected to the corresponding motor terminals:  forward direction  reverse direction

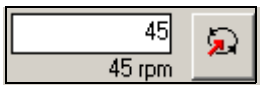
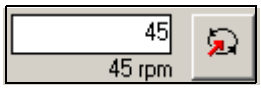
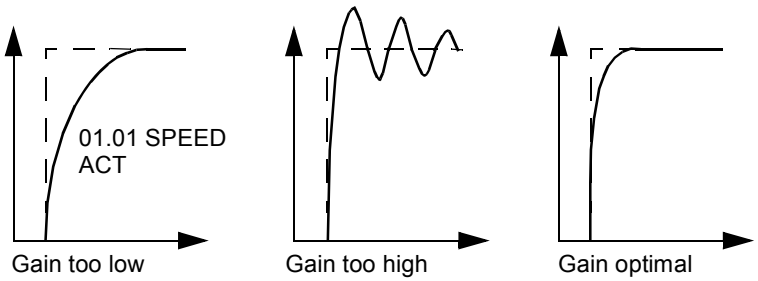
☐	Select the motor identification method by parameter 99.13 IDRUN MODE. During the Motor ID run, the drive will identify the characteristics of the motor for optimum motor control. The ID run is performed at the next start of the drive. **Note:** The motor shaft must NOT be locked and the load torque must be < 10% during Normal or Reduced ID run. With permanent magnet motor this restriction applies also when Standstill ID run is selected. **Note:** The ID run cannot be performed if par. 99.05 MOTOR CTRL MODE = SCALAR. NORMAL ID run should be selected when ever it is possible. **Note:** The driven machinery must be de-coupled from the motor with Normal ID run: - if the load torque is higher than 20%. - if the machinery is not able to withstand the nominal torque transient during the ID run. The REDUCED ID run should be selected instead of the Normal ID run if the mechanical losses are higher than 20%, i.e. the motor cannot be de-coupled from the driven equipment, or full flux is required to keep the motor brake open (conical motor). The STANDSTILL ID run should be selected only if the Normal or Reduced ID run is not possible due to the restrictions caused by the connected mechanics (e.g. with lift or crane applications). AUTOPHASING can only be selected after the Normal/Reduced/ Standstill ID run has been performed once. Autophasing is used when an absolute encoder has been added/changed to a permanent magnet motor, but there is no need to perform the Normal/Reduced/ Standstill ID run again. See parameter 11.07 on page 79 for information on autophasing modes.	99.13 IDRUN MODE 11.07 AUTOPHASING MODE
☐	Check the drive limits. The following must apply for all ID run methods: - 20.05 MAXIMUM CURRENT ≥ 99.06 MOT NOM CURRENT In addition, the following must apply for Reduced and Normal ID run: - 20.01 MAXIMUM SPEED > 55% of 99.09 MOT NOM SPEED - 20.02 MINIMUM SPEED ≤ 0 - supply voltage must be ≥ 65% of 99.07 MOT NOM VOLTAGE - 20.06 MAXIMUM TORQUE ≥ 100% (only for Normal ID run). When the ID run has been successfully completed, set the limit values as required by the application.	

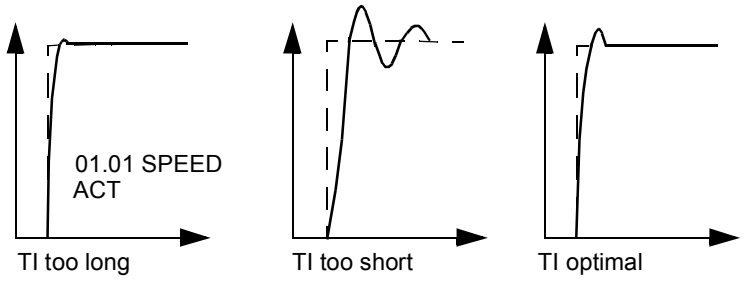
☐	Start the motor to activate the ID run. **Note:** RUN ENABLE must be active. ID run is indicated by alarm ID-RUN and by a rotating display on the 7-segment display.	 10.09 RUN ENABLE Alarm: ID-RUN 7-segment display: 
☐	If the ID run is not successfully completed, fault ID-RUN FAULT is generated.	Fault ID-RUN FAULT
Speed measurement with encoder/resolver		
An encoder/resolver feedback can be used for more accurate motor control. Follow these instructions when encoder/resolver interface module FEN-xx is installed in drive option Slot 1 or 2. **Note:** Two encoder interface modules of the same type are not allowed.		
☐	Select the used encoder/resolver. For more information, see firmware block ENCODER on page 164.	90.01 ENCODER 1 SEL / 90.02 ENCODER 2 SEL
☐	Set other necessary encoder/resolver parameters. - Absolute encoder parameters are in group 91. - Resolver parameters are in group 92. - Pulse encoder parameters are in group 93. For more information, see firmware blocks ABSOL ENC CONF on page 169, RESOLVER CONF on page 174 and PULSE ENC CONF on page 176.	91.01…91.31 / 92.01…92.03 / 93.01…93.22
☐	Save new parameters settings into the permanent memory by setting parameter 16.07 PARAM SAVE to value SAVE.	16.07 PARAM SAVE
☐	Set parameter 90.10 ENC PAR REFRESH o 1 (or switch the drive power off and on again) so that the new parameter settings take effect.	90.10 ENC PAR REFRESH
Checking the encoder/resolver connection		
Follow these instructions when encoder/resolver interface module FEN-xx is installed in drive option Slot 1 or 2. **Note:** Two encoder interface modules of the same type are not allowed.		
☐	Set parameter 22.01 SPEED FB SEL to ESTIMATED.	22.01 SPEED FB SEL
☐	Enter a small speed reference value (for example 3% of the nominal motor speed).	
☐	Start the motor.	

☐	Check that the estimated (1.14 SPEED ESTIMATED) and actual speed (1.08/1.10 ENCODER 1/2 SPEED) are equal. If the values differ, check the encoder/resolver parameter settings. **Hint:** If the actual speed (with absolute or pulse encoder) differs form the reference value by a factor of 2, check the pulse number setting (91.01 SINE COSINE NR / 93.01/93.11 ENC1/2 PULSE NR).	1.14 SPEED ESTIMATED 1.08 ENCODER 1 SPEED / 1.10 ENCODER 2 SPEED
☐	If the direction of rotation is selected as forward, check that the actual speed (1.08/1.10 ENCODER 1/2 SPEED) is positive: - If the actual direction of the rotation is forward and the actual speed negative, the phasing of the pulse encoder wires is reversed. - If the actual direction of the rotation is reverse and the actual speed negative, the motor cables are incorrectly connected. Changing the connection: Disconnect the main power, and wait for 5 minutes for the intermediate circuit capacitors to discharge. Do the necessary changes. Switch the power on and start the motor again. Check that the estimated and actual speed values are correct. If the direction of rotation is selected as reverse, the actual speed must be negative. **Note:** Resolver autotuning routines should always be performed after resolver cable connection has been modified. Autotuning routines can be activated by setting parameter 92.02 EXC SIGNAL AMPL or 92.03 EXC SIGNAL FREQ, and then setting parameter 90.10 ENC PAR REFRESH to 1. If the resolver is used with a permanent magnet motor, an AUTOPHASING ID run should be performed as well.	1.08 ENCODER 1 SPEED / 1.10 ENCODER 2 SPEED
☐	Stop the motor.	
☐	Set parameter 22.01 SPEED FB SEL to ENC1 SPEED or ENC2 SPEED. If the speed feedback cannot be used in motor control: In special applications parameter 40.06 FORCE OPEN LOOP must be set to TRUE.	22.01 SPEED FB SEL
☐	**Note:** Speed filtering needs to be adjusted especially when the encoder pulse number is small. See section Speed filtering on page 25.	
Emergency stop circuit		
☐	If there is an emergency stop circuit in use, check that the circuit functions (emergency stop signal is connected to the digital input which is selected as the source for the emergency stop activation).	10.10 EMERGENCY STOP OFF3 or 10.11 EMERGENCY STOP OFF1 (emergency stop control through fieldbus 2.12 FBA MAIN CW bits 2…4)

Safe Torque Off		
The Safe Torque Off function disables the control voltage of the power semiconductors of the drive output stage, thus preventing the inverter from generating the voltage required to rotate the motor. For Safe Torque Off wiring, see the appropriate hardware manual.		
☐	If there is a Safe Torque Off circuit in use, check that the circuit functions.	
☐	Selects how the drive reacts when the Safe Torque Off function is active (i.e. when the control voltage of the power semiconductors of the drive output stage is disabled).	46.07 STO DIAGNOSTIC
Voltage control		
If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. To prevent the DC voltage from exceeding the overvoltage control limit, the overvoltage controller automatically decreases the generating torque when the limit is reached. When the overvoltage controller is limiting the generating torque, quick deceleration of the motor is not possible. Thus electrical braking (brake chopper and brake resistor) is needed in some applications to allow the drive to dissipate regenerative energy. The chopper connects the brake resistor to the intermediate circuit of the drive whenever the DC voltage exceeds the maximum limit.		
☐	Check that the overvoltage and undervoltage controllers are active.	47.01 OVERVOLTAGE CTRL 47.02 UNDERVOLTAGE CTRL
☐	If the application requires a brake resistor (the drive has a built-in brake chopper): - Set the brake chopper and resistor settings. **Note:** When a brake chopper and resistor are used, the overvoltage controller must be deactivated by parameter 47.01 OVERVOLTAGE CTRL. - Check that the connection functions. For more information on the brake resistor connection, see the appropriate hardware manual.	48.01…48.07 47.01 OVERVOLTAGE CTRL.
Start function		
☐	Select the start function. Setting 11.01 START MODE to AUTOMATIC selects a general-purpose start function. This setting also makes flying start (starting to a rotating motor) possible. The highest possible starting torque is achieved when 11.01 START MODE is set to FAST (automatic optimised DC magnetising) or CONST TIME (constant DC magnetising with user-defined magnetising time). **Note:** When 11.01 START MODE setting is FAST or CONST TIME, flying start (start to a rotating motor) is not possible.	11.01 START MODE

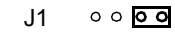
Limits		
☐	Set the operation limits according to the process requirements. **Note:** If load torque is suddenly lost when the drive is operating in torque control mode, the drive will rush to the defined negative or positive maximum speed. For safe operation, ensure the set limits are suitable for your application.	20.01…20.07
Motor overtemperature protection (2)		
☐	Set the alarm and fault limits for the motor overtemperature protection.	45.03 MOT TEMP ALM LIM 45.04 MOT TEMP FLT LIM
☐	Set the typical ambient temperature of the motor.	45.05 AMBIENT TEMP
☐	When 45.02 MOT TEMP SOURCE setting is ESTIMATED, the motor thermal protection model must be configured as follows: - Set the maximum allowed operating load of the motor. - Set the zero speed load. A higher value can be used if the motor has an external motor fan to boost the cooling. - Set the break point frequency of the motor load curve. - Set the motor nominal temperature rise. - Set the time inside which the temperature has reached 63% of the nominal temperature.	45.06 MOT LOAD CURVE 45.07 ZERO SPEED LOAD 45.08 BREAK POINT 45.09 MOTNOMTEMPRISE 45.10 MOT THERM TIME
☐	If possible, perform the motor ID run again at this point (see page 20).	99.13 IDRUN MODE
Speed filtering		
The measured speed always has a small ripple because of electrical and mechanical interferences, couplings and encoder resolution (i.e. small pulse number). A small ripple is acceptable as long as it does not affect the speed control chain. The interferences in the speed measurement can be filtered with a speed error filter or with an actual speed filter. Reducing the ripple with filters may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.		
☐	If the used speed reference changes rapidly (servo application), use the speed error filter to filter the possible interferences in the speed measurement. In this case the speed error filter is more suitable than the actual speed filter: - Set the filter time constant.	26.06 SPD ERROR FILT TIM

☐	If the used speed reference remains constant, use the actual speed filter to filter the possible interferences in the speed measurement. In this case the actual speed filter is more suitable than the speed error filter: - Set the filter time constant. If there are substantial interferences in the speed measurement, the filter time constant should be proportional to the total inertia of the load and motor, i.e. approximately 10…30% of the mechanical time constant $t_{mech} = (n_{nom} / T_{nom}) \times J_{tot} \times 2\pi / 60$, where J_{tot} = total inertia of the load and motor (the gear ratio between the load and the motor must be taken into account) n_{nom} = motor nominal speed T_{nom} = motor nominal torque	22.02 SPEED ACT FTIME
Manual speed controller tuning		
☐	Select the following signals to be monitored with the DriveStudio Data Logger or Monitoring Window: - 1.01 SPEED ACT, filtered actual speed - 1.06 TORQUE, motor torque.	
☐	Start the motor with a small speed reference.	
Give a speed reference step and monitor the response. Repeat the test for few speed reference steps across the whole speed range:		
☐	Set the speed ramp time to a suitable value (according to the used application).	25.03 ACC TIME
☐	Set a suitable speed step (according to the used application): 10% or 20% of the maximum speed of the drive. Accept the new value by pressing the Set new reference button.	
☐	Optimise the P-part of the speed controller: Set the integration time to 0 to change the PI (proportional integral) controller into a P controller:	28.03 INTEGRATION TIME
☐	Give a step change up, for example 10% (of the maximum speed of the drive). When the speed is stabilised, give a step change down, for example -10% (of the maximum speed of the drive).	
☐	Increase the proportional gain until the response is sufficient: 	28.02 PROPORT GAIN

☐	Reduce the integration time (TI) until an overshoot is observed in the response. Adjust the integration time so that there is no overshoot or only a slight overshoot (depending on the drive application). The integral part is used to correct the error between the reference and actual value (which is caused by the proportional control) as quickly as possible. If the drive is stable and allows a high proportional gain, an overcompensated step response is obtained if the integration time is set short. 	28.03 INTEGRATION TIME
☐	Acceleration (deceleration) compensation can be used to improve the speed control dynamic reference change (when the speed ramp times > 0). In order to compensate inertia during acceleration, a derivative of the speed reference is added to the output of the speed controller. - Set the derivation time for acceleration (deceleration) compensation. The value should be proportional to the total inertia of the load and motor, i.e. approximately 10…30% of the mechanical time constant (t_{mech}). See the mechanical time constant equation in section Speed filtering on page 25.	26.08 ACC COMP DERTIME
Fieldbus control		
Follow these instructions when the drive is controlled from a fieldbus control system via fieldbus adapter Fxxx. The adapter is installed in drive Slot 3.		
☐	Enable the communication between the drive and fieldbus adapter.	50.01 FBA ENABLE
☐	Connect the fieldbus control system to the fieldbus adapter module.	
☐	Set the communication and adapter module parameters: See section Setting up communication through a fieldbus adapter module on page 144.	
☐	Test that the communication functions.	

How to control the drive through the I/O interface

The table below instructs how to operate the drive through the digital and analogue inputs, when the default parameter settings are valid.

PRELIMINARY SETTINGS	
Ensure the original parameter settings (default) are valid.	16.04 PAR FACTORY RESTORE
Ensure the control connections are wired according to the connection diagram given in chapter *Default connections of the control unit.*	
Switch to external control by clicking the Take/Release button of the PC tool control panel.	
STARTING AND CONTROLLING THE SPEED OF THE MOTOR	
Start the drive by switching digital input DI1 on. Digital input status can be monitored with signal 2.01 DI STATUS.	2.01 DI STATUS
Check that analogue input AI1 is used as a voltage input (selected by jumper J1).	Voltage: J1 
Regulate the speed by adjusting the voltage of analogue input AI1.	
Check analogue input AI1 signal scaling. AI1 values can be monitored with signals 2.04 AI1 and 2.05 AI1 SCALED. When AI1 is used as a voltage input, the input is differential and the negative value corresponds to the negative speed and the positive value to the positive speed.	13.02...13.04 2.04 AI1 2.05 AI1 SCALED
STOPPING THE MOTOR	
Stop the drive by switching digital input DI1 off.	2.01 DI STATUS

Drive programming via PC tool

What this chapter contains

This chapter introduces the drive programming via PC tool. The PC tool consists of DriveStudio and Solution Program Composer (SPC).

For more information, see *DriveStudio User Manual* [3AFE68749026 (English)] and *Solution Program Composer User Manual* [3AFE68836590 (English)].

General

The drive control program is divided into two parts:

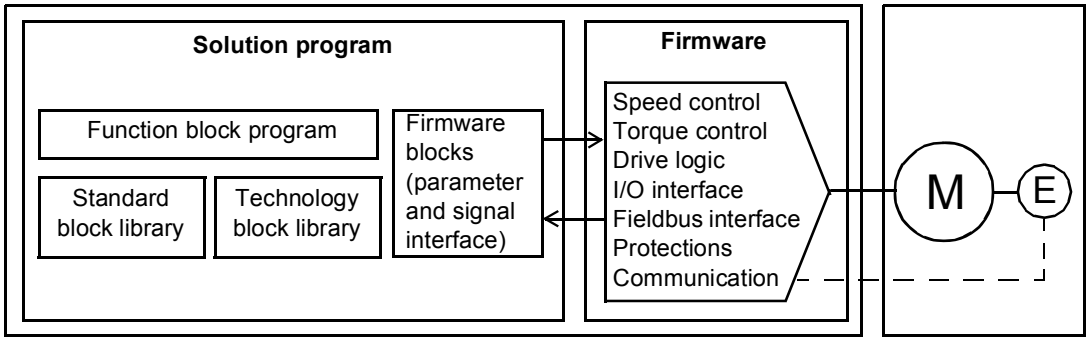
- firmware program
- solution program.

The firmware program performs the main control functions, including speed and torque control, drive logic (start/stop), I/O, feedback, communication and protection functions. Firmware functions are configured and programmed with parameters. The functions of the firmware program can be extended with solution programming. Solution programs are built out of function blocks.

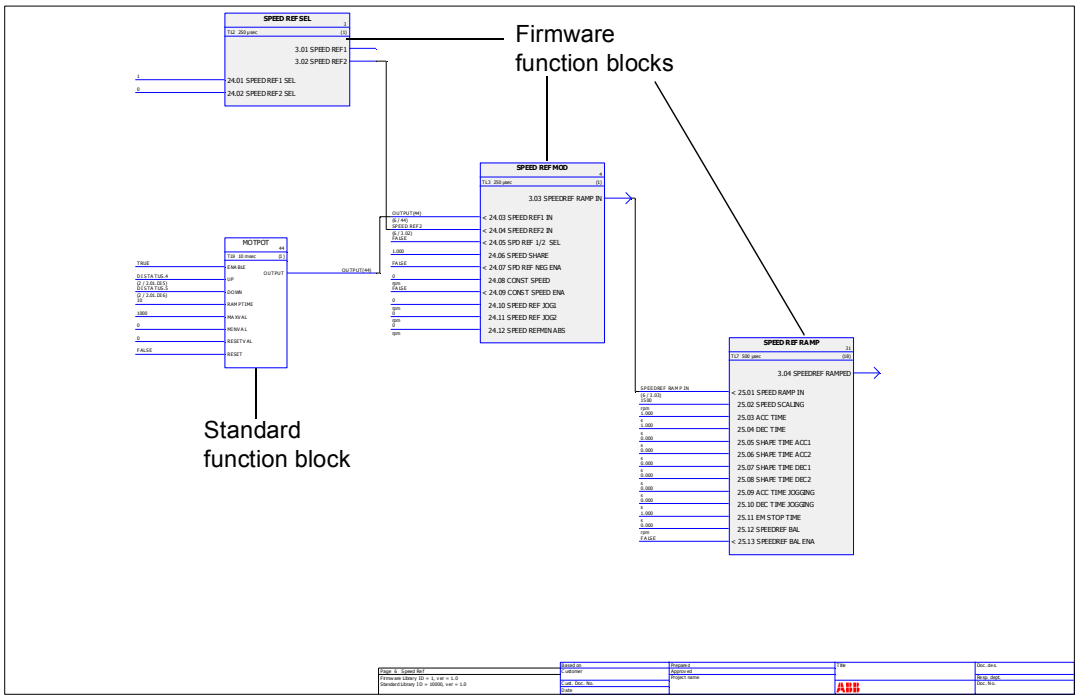
The drive supports two different programming methods:

- parameter programming
- solution programming with function blocks (the blocks are based on the IEC-61131 standard).

Drive control program



The following picture presents a view from the Solution Program Composer.



Programming via parameters

Parameters can be set via DriveStudio, drive control panel (keypad) or the fieldbus interface. All parameter settings are stored automatically to the permanent memory of the drive. (Exception: Parameters set via the fieldbus interface must be saved by par. 16.07 PARAM SAVE). Values are restored after the power switch-off. Default values can be restored by a parameter (16.04 PAR FACTORY RESTORE).

Because parameters are used as firmware function block inputs, parameter values can also be modified via the Solution Program Composer.

Solution programming

Solution programs are created with the Solution Program Composer (SPC) of the PC tool.

The normal delivery of the drive does not include a solution program. The user can create a solution program with the standard and firmware function blocks. ABB also offers customised solution programs and technology function blocks for specific applications. For more information, contact your local ABB representative.

Function blocks

The solution program uses three types of function blocks: firmware function blocks, standard function blocks and technology function blocks.

Firmware function blocks

Most of the firmware functions are represented as function blocks in the Solution Program Composer. Firmware function blocks are part of the drive control firmware, and used as an interface between the solution and firmware programs. Drive parameters (groups 10…99) are used as function block inputs and drive signals (groups 1…9) as function block outputs. Firmware function blocks are presented in chapter Firmware functions, parameters and signals.

Standard function blocks (library)

Standard function blocks (e.g. ADD, AND) are used to create an executable solution program. Blocks are based on the IEC-61131 standard. Standard function blocks are presented in chapter Standard function blocks.

Standard function block library is always included in the drive delivery.

Technology function blocks

Several technology function block libraries are available for different types of applications. One technology library can be used at a time. Technology blocks are used in a similar way as the standard blocks.

Program execution

Solution program is loaded to the permanent memory (non-volatile) of the memory unit (JMU). The execution of the downloaded program starts after the next reset of the drive control board. The program is executed in real time on the same Central Processing Unit (CPU of the drive control board) as the drive firmware. The program is executed with two cyclical tasks. The time level for these tasks can be defined by the programmer ($\geq$ 1ms).

Note: Because the firmware and solution programs use the same CPU, the programmer must ensure that the drive CPU is not overloaded. For information on how to determine the solution program load, see *Solution Program Composer User Manual* [3AFE68836590 (English)].

Operation modes

The Solution Program Composer offers the following operation modes:

Off-line

When the off-line mode is used without a drive connection, the user can

- open a solution program file (if exists).
- modify and save the solution program.
- print the program pages.

When the off-line mode is used with a drive(s) connection, the user can

- connect the selected drive to the SPC.
- upload a solution program from the connected drive (an empty template which includes only the firmware blocks is available as default.)
- download the configured solution program to the drive and start the program execution. The downloaded program contains the function block program and the parameter values set in the SPC.
- remove the program from the connected drive.

On-line

In the on-line mode, the user can

- modify firmware parameters (changes are stored directly to the drive memory).
- modify solution program parameters (i.e. parameters created in the SPC).
- monitor the actual values of all function blocks in real time.

Solution program examples for typical applications will be added to this manual later.

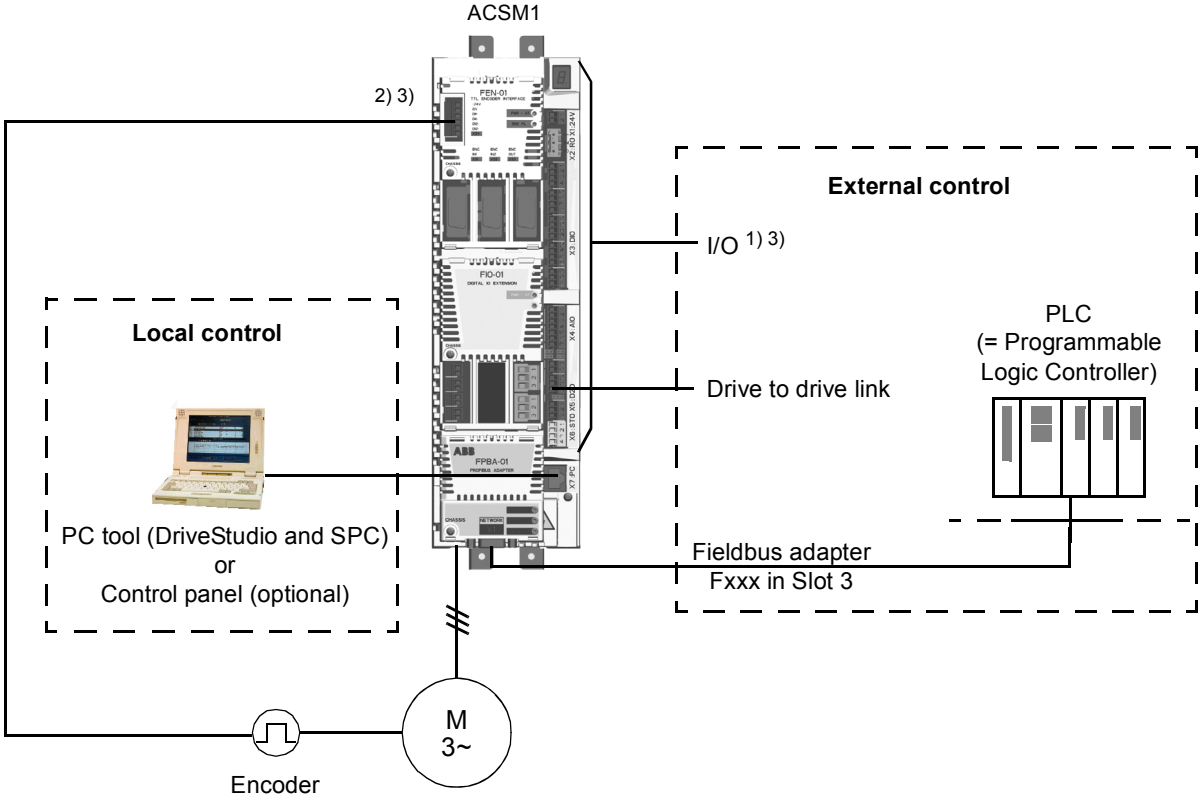
Control locations and operating modes

What this chapter contains

This chapter describes the control locations and operation modes of the drive, and presents the drive control chain in block diagram form.

Local control vs. external control

The drive has two main control locations: external and local. The control location is selected with the PC tool (Take/Release button) or with the LOC/REM key on the control panel.



1) Extra inputs/outputs can be added by installing optional I/O extension modules (FIO-01, FIO-11) in drive Slot 1/2.
2) Incremental or absolute encoder, or resolver interface module (FEN-01, FEN-11 or FEN-21) installed in drive Slot 1/2
3) Two encoder/resolver interface modules or two I/O extension modules of the same type are not allowed.

Local control

The control commands are given from a PC equipped with DriveStudio and Solution Program Composer (SPC) or from the control panel keypad when the drive is in local control. Speed and torque control modes are available for local control.

Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Changing the control location to local can be disabled by parameter *16.01* LOCAL LOCK.

The user can select by a parameter (*46.03* LOCAL CTRL LOSS) how the drive reacts to a control panel or PC tool communication break.

External control

When the drive is in external control, control commands are given through the fieldbus interface (via an optional fieldbus adapter module), the I/O terminals (digital and analogue inputs), optional I/O extension modules or the drive-to-drive link. External references are given through the fieldbus interface, analogue inputs, drive to drive link and encoder inputs.

Two external control location, EXT1 and EXT2, are available. The user can select control signals (e.g. start and stop) and control modes for both external control locations. Depending on the user selection, either EXT1 or EXT2 is active at a time. Selection between EXT1/EXT2 is done via digital inputs or fieldbus control word.

Operating modes of the drive

The drive can operate in speed and torque control modes. A block diagram of the drive control chain is presented further below.

Speed control mode

Motor rotates at a speed proportional to the speed reference given to the drive. This mode can be used either with estimated speed used as feedback, or with an encoder or resolver for better speed accuracy.

Speed control mode is available in both local and external control.

Torque control mode

Motor torque is proportional to the torque reference given to the drive. This mode can be used either with estimated speed used as feedback, or with an encoder or resolver for more accurate and dynamic motor control.

Torque control mode is available in both local and external control.

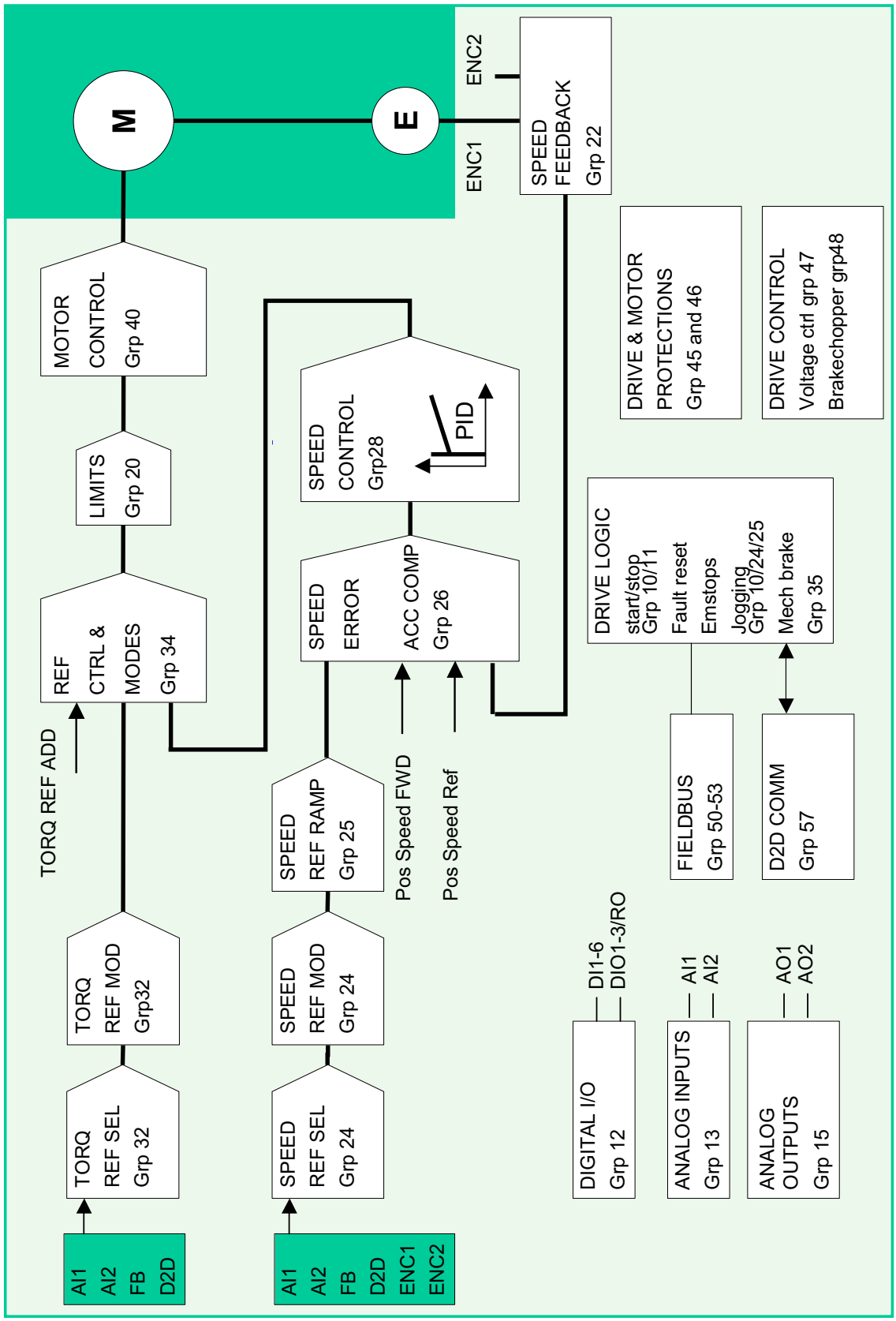
Special control modes

In addition to the speed and torque control modes, the following special control modes are available:

- Emergency Stop modes OFF1 and OFF3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated.

For more information, see firmware block *DRIVE LOGIC* on page *64*.

Drive control chain for speed and torque control



Default connections of the control unit

What this chapter contains

This chapter shows the default control connections of the JCU Control Unit.

More information on the connectivity of the JCU is given in the *Hardware Manual* of the drive.

The figure below shows the default external control connections for the speed and torque control.

Notes:

*Total maximum current: 200 mA

1) Selected by parameter 12.01 DIO1 CONF.

2) Selected by parameter 12.02 DIO2 CONF.

3) Selected by parameter 12.03 DIO3 CONF.

4) Selected by jumper J1.

5) Selected by jumper J2.

Current:

J1/2

Voltage:

J1/2

		X1
External power input 24 V DC, 1.6 A	+24VI	1
	GND	2
		X2
Relay output: Brake close/open 250 V AC / 30 V DC 2 A	NO	1
	COM	2
	NC	3
		X3
+24 V DC*	+24VD	1
Digital I/O ground	DGND	2
Digital input 1: Stop/start (par. 10.02 and 10.05)	DI1	3
Digital input 2: EXT1/EXT2 (par. 34.01)	DI2	4
+24 V DC*	+24VD	5
Digital I/O ground	DGND	6
Digital input 3: Fault reset (par. 10.08)	DI3	7
Digital input 4: Not connected	DI4	8
+24 V DC*	+24VD	9
Digital I/O ground	DGND	10
Digital input 5: Not connected	DI5	11
Digital input 6: Not connected	DI6	12
+24 V DC*	+24VD	13
Digital I/O ground	DGND	14
Digital input/output 1 [1]: Ready	DIO1	15
Digital input/output 2 [2]: Running	DIO2	16
+24 V DC*	+24VD	17
Digital I/O ground	DGND	18
Digital input/output 3 [3]: Fault	DIO3	19
		X4
Reference voltage (+)	+VREF	1
Reference voltage (–)	–VREF	2
Ground	AGND	3
Analogue input 1 (mA or V) [4]: Speed reference (par. 24.01)	AI1+	4
	AI1–	5
Analogue input 2 (mA or V) [5]: Torque reference (par. 32.01)	AI2+	6
	AI2–	7
AI1 current/voltage selection		J1
AI2 current/voltage selection		J2
Thermistor input	TH	8
Ground	AGND	9
Analogue output 1 (mA): Output current	AO1 (I)	10
Analogue output 2 (V): Actual speed	AO2 (U)	11
Ground	AGND	12
		X5
Drive-to-drive link termination		J3
Drive-to-drive link	B	1
	A	2
	BGND	3
		X6
Safe Torque Off. Both circuits must be closed for the drive to start. See the appropriate drive hardware manual.	OUT1	1
	OUT2	2
	IN1	3
	IN2	4
Control panel connection		**X7**

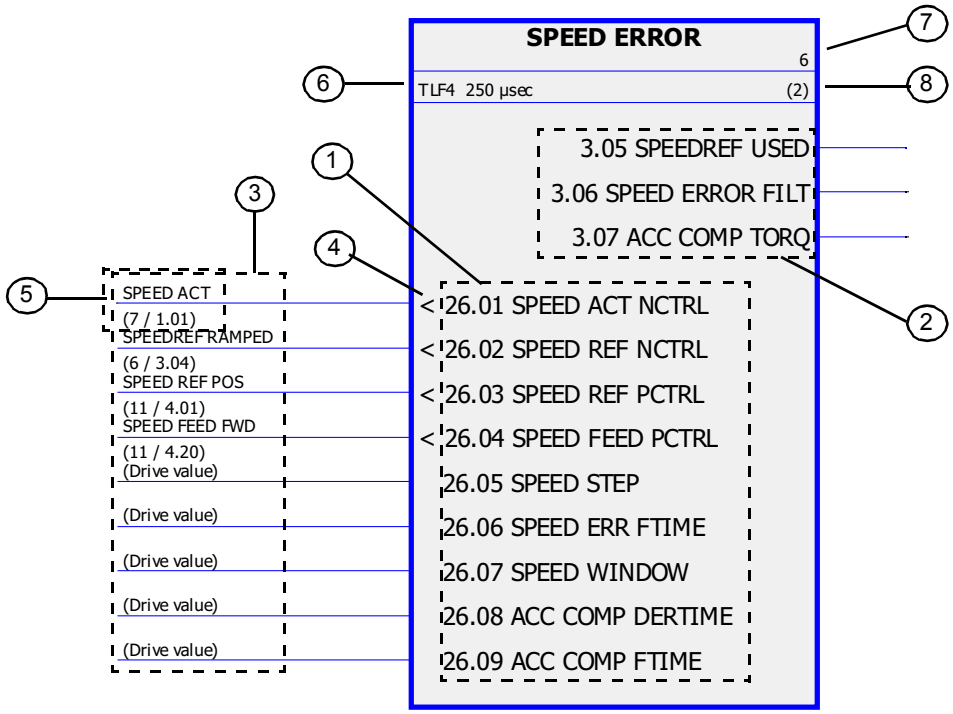
Firmware functions, parameters and signals

What this chapter contains

This chapter describes the firmware function blocks and the associated input parameters and output signals.

The number in brackets in the firmware block heading is the block ID number.

Firmware block layout



1	Input parameters
2	Output signals
3	Input parameter values
4	Pointer parameter indicator “<“
5	Parameter 26.01 is set to value P.1.1, i.e. signal 1.01 SPEED ACT. The SPEED ACT signal can be found on page 7 of the Solution Program Composer.
6	ID of the time level (TL4) and time level (250 µs). Time level, i.e. update cycle, is application-specific. See the time level of the block in the Solution Program Composer.
7	Firmware block ID number
8	Firmware block execution order for the selected update cycle ID

Actual signals

Actual signals (parameter groups 1…9) are signals measured or calculated by the drive. They are normally used for monitoring and diagnostics, and cannot be adjusted by the user. For additional actual signal data, e.g. update cycle and fieldbus equivalent, see chapter *Parameter and signal data*.

Parameters

Parameters are user-adjustable operation instructions of the drive (groups 10…99). There are three different types of parameters: Value parameters, value pointer parameters and bit pointer parameters.

Value parameter

A value parameter has a fixed set of choices or a setting range.

Example 1: Motor phase loss supervision is activated by selecting FAULT from the selection list of parameter *46.06* MOT PHASE LOSS.

Example 2: The motor nominal power (kW) is set by writing the appropriate value to parameter *99.10* MOT NOM POWER, e.g. 10.

Value pointer parameter

A value pointer parameter points to the value of another parameter/signal. The source parameter is given in format **P.xx.yy**, where xx = Parameter group; yy = parameter index.

Example: Motor current signal, *1.05* CURRENT PERC, is connected to analogue output AO1 by setting parameter *15.01* AO1 PTR to value P.01.05.

Bit pointer parameter

A bit pointer parameter points to the value of a bit in another signal, or can be fixed to 0 (FALSE) or 1 (TRUE).

When adjusting a bit pointer parameter on the optional control panel, CONST is selected in order to fix the value to 0 (displayed as “C.FALSE”) or 1 (“C.TRUE”). POINTER is selected to define a source from another signal.

A pointer value is given in format **P.xx.yy.zz**, where xx = Parameter group; yy = Parameter index, zz = Bit number.

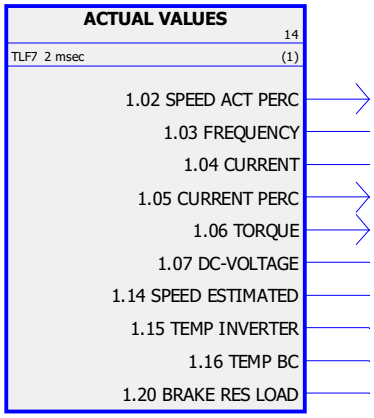
Example: Digital input DI5 status, *2.01* DI STATUS bit 4, is used for brake supervision by setting parameter *35.02* BRAKE ACKNOWL to value P.02.01.04.

Note: Pointing to a nonexisting bit will be interpreted as 0 (FALSE).

For additional parameter data, e.g. update cycle and fieldbus equivalent, see chapter *Parameter and signal data*.

ACTUAL VALUES

(14)



Description

The ACTUAL VALUE block shows actual signals measured or calculated by the drive. Values are only for monitoring, i.e. they cannot be set by user. See also signals 1.01, 1.08, 1.09, 1.10, 1.11, 1.17, 1.18 and 9.01….9.22.

Outputs

1.02 SPEED ACT PERC

Actual speed in percent of the motor synchronous speed

1.03 FREQUENCY

Estimated drive output frequency in Hz

1.04 CURRENT

Measured motor current in A

1.05 CURRENT PERC

Motor current in percent of the nominal motor current

1.06 TORQUE

Motor torque in percent of the motor nominal torque

1.07 DC-VOLTAGE

Measured intermediate circuit voltage in V

1.14 SPEED ESTIMATED

Estimated motor speed in rpm

1.15 TEMP INVERTER

Measured temperature of the heatsink in Celsius

1.16 TEMP BC

Brake chopper IGBT temperature in Celsius

1.20 BRAKE RES LOAD

Estimated temperature of the braking resistor. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter 48.04 BR POWER MAX.

1.21 CPU USAGE

Microprocessor load in percent.

SYSTEM INFO

Note: The SYSTEM INFO signals do not belong to any firmware block, i.e. they are only available via the optional control panel or the PC tool Parameter Browser.

Description

The SYSTEM INFO signals display the application type, the firmware type, name and version and the optional module type in drive option Slot 1/2/3.

Signals

9.01 DRIVE TYPE

Displays the drive application type.
1 = ACSM1 SPEED: Speed and torque control application
2 = ACSM1 MOTION: Motion control application.

9.02 DRIVE RATING ID

Displays the inverter type of the drive: 1= ACSM1-02A5-4, 2 = ACSM1-03A0-4,3 = ACSM1-04A0-4, 4 = ACSM1-05A0-4, 5 = ACSM1-07A0-4, 6 = ACSM1-09A5-4, 7 = ACSM1-012A-4, 8 = ACSM1-016A-4, 9 = ACSM1-024A-4, 10 = ACSM1-031A-4, 11 = ACSM1-040A-4, 12 = ACSM1-046A-4, 13 = ACSM1-060A-4, 14 = ACSM1-073A-4, 15 = ACSM1-090A-4.

9.03 FIRMWARE ID

Displays the firmware name. E.g. UMFI.

9.04 FIRMWARE VER

Displays the version of the firmware package in the drive (in hexadecimal format), e.g. 0x1210.

9.20 OPTION SLOT 1

Displays the type of the optional module in option Slot 1. 0 = NO OPTION, 1 = NO COMM, 2 = UNKNOWN, 3 = FEN-01, 4 = FEN-11, 5 = FEN-21, 6 = FIO-01, 7 = FIO-11, 8 = FPBA-01, 9 = FPBA-02, 10 = FCAN-01, 11 = FDNA-01, 12 = FENA-01, 13 = FENA-02, 14 = FLON-01, 15 = FRSA-00, 16 = FMBA-01, 17 = FFOA-01, 18 = FFOA-02.

9.21 OPTION SLOT 2

Displays the type of the optional module in option Slot 2. See signal 9.20 OPTION SLOT 1.

9.22 OPTION SLOT 3

Displays the type of the optional module in option Slot 3. See signal 9.20 OPTION SLOT 1.

START-UP DATA

(2)

Note: The START-UP DATA parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

With the START-UP DATA block the user can select the language and enter the motor data. Motor data can be entered either by selecting a specific motor catalogue by parameter 99.02 MOTOR CATALOGUE or manually by setting motor parameters 99.04…99.12.

Note: Motor catalogue feature is not supported yet.

The motor nominal values must be set before the drive is started. For detailed instructions, see chapter Start-up.

Inputs

When motor catalogue (99.02) is not used for the entering the motor data:

- With scalar control, the following parameters must be set: 99.06…99.08.

- With DTC control, the following parameters must be set: 99.06…99.10. Better control accuracy is achieved by also setting parameters 99.11…99.12.

99.01 LANGUAGE

Note: Language selection is not supported yet.

Selects the language.

ENGLISH

DEUTCH

ITALIANO

99.02 MOTOR CATALOGUE

Note: Motor catalogue is not supported yet.

Selects the motor catalogue.

99.03 MOTOR SELECTION

Note: Motor catalogue is not supported yet.

Selects the motor from the catalogue selected by parameter 99.02 MOTOR CATALOGUE.

99.04 MOTOR TYPE

Selects the motor type.

Note: This parameter cannot be changed while the drive is running.

0 = AM: Asynchronous motor. Three phase AC voltage supplied induction motor with squirrel cage rotor.

1 = PMSM: Permanent magnet motor. Three phase AC voltage supplied synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage.

99.05 MOTOR CTRL MODE

Note: Control mode selection is not supported yet. Direct Torque Control is always used.

Selects the motor control mode.

0 = DTC: Direct Torque Control mode is suitable for most applications.

1 = SCALAR: Scalar control is suitable in special cases where the DTC cannot be applied. In Scalar Control, the drive is controlled with a frequency reference. The outstanding motor control accuracy of the DTC cannot be achieved in scalar control. There are some standard features that are disabled in the scalar control mode, for example motor identification run (99.13), torque limits (LIMITS), DC hold and DC magnetising (11.04…11.06, 11.01).

Note: Correct motor run requires that the magnetising current of the motor does not exceed 90 percent of the nominal current of the inverter.

Note: Scalar control mode must be used

- with multimotor applications with variable number of motors

- if the nominal current of the motor is less than 1/6 of the nominal output current of the drive.

It is recommended to activate the scalar control mode in the following special applications:

- In multimotor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification.

- If the drive is used with no motor connected (e.g. for test purposes).

99.06 MOT NOM CURRENT

Defines the nominal motor current. Must be equal to the value on the motor rating plate. If several motors are connected to the inverter, enter the total current of the motors.

Note: Correct motor run requires that the magnetising current of the motor does not exceed 90 percent of the nominal current of the inverter.

Note: This parameter cannot be changed while the drive is running.

Range: 0…6400 A

Allowed range: 1/6…2 · I_{2N} of drive (parameter 99.05 MOTOR CTRL MODE = DTC).

Allowed range: 0…2 · I_{2N} of drive (parameter 99.05 MOTOR CTRL MODE = SCALAR).

99.07 MOT NOM VOLTAGE

Defines the nominal motor voltage. Nominal voltage is a fundamental phase to phase rms voltage, which is supplied to the motor at the nominal operating point. This parameter value must be equal to the value on the asynchronous motor name plate.

Note: With permanent magnet motors, the nominal voltage is the BackEMF voltage (at motor nominal speed). If the voltage is given as voltage per rpm, e.g. 60 V per 1000 rpm, the voltage for 3000 rpm nominal speed is 3 × 60 V = 180 V. Note that the nominal voltage is not equal to the equivalent DC motor voltage (E.D.C.M.) value given by some motor manufactures. The nominal voltage can be calculated by dividing the E.D.C.M. voltage by 1.7 (= square root of 3).

Note: The stress on the motor insulations is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than the rating of the drive and the supply of the drive.

Note: This parameter cannot be changed while the drive is running.

Range: 80…960 V. Allowed range is 1/6…2 · U_N of the drive.

99.08 MOT NOM FREQ

Defines the nominal motor frequency.

Note: This parameter cannot be changed while the drive is running.

Range: 5…500 Hz

99.09 MOT NOM SPEED

Defines the nominal motor speed. Must be equal to the value on the motor rating plate. When parameter value is changed, check the speed limits in function block LIMITS on page *83*.

Note: This parameter cannot be changed while the drive is running.

Range: 0…10000 rpm

99.10 MOT NOM POWER

Defines the nominal motor power. Must be equal to the value on the motor rating plate. If several motors are connected to the inverter, enter the total power of the motors. Set also parameter 99.11 MOT NOM COSFII.

Note: This parameter cannot be changed while the drive is running.

Range: 0…10000 kW

99.11 MOT NOM COSFII

Defines the cosφ (not applicable to permanent magnet motors) for a more accurate motor model. Not obligatory; if set, should be equal to the value on the motor rating plate.

Note: This parameter cannot be changed while the drive is running.

Range: 0…1. By setting the value to 0, the parameter is disabled.

99.12 MOT NOM TORQUE

Defines the nominal motor shaft torque for a more accurate motor model. Not obligatory.

Note: This parameter cannot be changed while the drive is running.

Range: 0…2147483 Nm

99.13 IDRUN MODE

Selects the type of the motor identification performed at the next start of the drive (for Direct Torque Control). During the identification, the drive will identify the characteristics of the motor for optimum motor control. After the ID run, the drive is stopped. **Note:** This parameter cannot be changed while the drive is running.

Once the ID run is activated, it can be cancelled by stopping the drive: If ID run has already been performed once, parameter is automatically set to NO. If no ID run has been performed yet, parameter is automatically set to STANDSTILL. In this case, the ID run must be performed.

Note: ID run can only be performed in local control (i.e. when drive is controlled via PC tool or control panel).

Note: ID run cannot be performed if parameter 99.05 MOTOR CTRL MODE = SCALAR.
Note: ID run must be performed every time any of the motor parameters (99.04, 99.06…99.12) have been changed. Parameter is automatically set to STANDSTILL after the motor parameters have been set.
Note: With permanent magnet motor, the motor shaft must NOT be locked and the load torque must be < 10% during the ID run (Normal/Reduced/Standstill).
Note: Ensure that possible Safe Torque Off and emergency stop circuits are closed during ID run.

0 = NO: No motor ID run is requested. This mode can be selected only if the ID run (Normal/Reduced/Standstill) has already been performed once.

1 = NORMAL: Normal ID run. Guarantees the best possible control accuracy. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Note:** The driven machinery must be de-coupled from the motor with Normal ID run:

- if the load torque is higher than 20%.

- if the machinery is not able to withstand the nominal torque transient during the ID run.

Note: Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction.

****WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!

2 = REDUCED: Reduced ID Run. This mode should be selected instead of the Normal ID Run:

- if mechanical losses are higher than 20% (i.e. the motor cannot be de-coupled from the driven equipment)

- if flux reduction is not allowed while the motor is running (i.e. in case of a motor with an integrated brake supplied from the motor terminals).

With Reduced ID run, the control in the field weakening area or at high torques is not necessarily as accurate as with the Normal ID run. Reduced ID run is completed faster than the Normal ID Run (< 90 seconds).

Note: Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction.

****WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!

3 = STANDSTILL: Standstill ID run. The motor is injected with DC current. With asynchronous motor, the motor shaft is not rotating (with permanent magnet motor the shaft can rotate < 0.5 revolution).

Note: This mode should be selected only if the Normal or Reduced ID run is not possible due to the restrictions caused by the connected mechanics (e.g. with lift or crane applications).

4 = AUTOPHASING: During autophasing, the start angle of the motor is determined. Note that other motor model values are not updated. See also parameter 11.07.

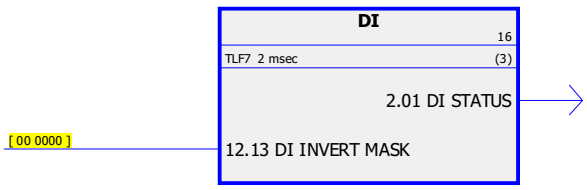
Note: Autophasing can only be selected after the Normal/Reduced/Standstill ID run has been performed once. Autophasing is used when an absolute encoder has been added/changed to a permanent magnet motor and there is no need to perform the Normal/Reduced/Standstill ID run again.

Note: During Autophasing the motor shaft must NOT be locked and the load torque must be < 5%.

5 = CUR MEAS CAL: Current offset and gain measurement calibration. The calibration will be performed at next start.

DI

(16)



Description

The DI block shows the DI status.

The drive offers six basic digital inputs DI1…DI6. The hardware filter time constant of the digital inputs is approximately 0.25 ms.

Inputs

12.13 DI INVERT MASK

Inverts status of digital inputs as reported by 2.01 DI STATUS. For example, a value of 0b000100 inverts the status of DI3 on the output.

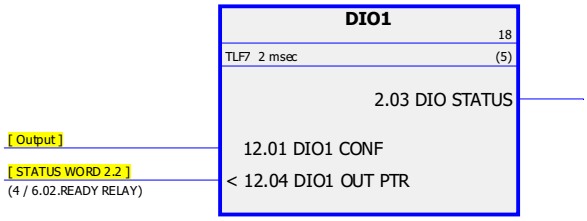
Outputs

2.01 DI STATUS

Status word of the digital inputs. Example: 000001 = DI1 is on, DI2 to DI6 are off.

DIO1

(18)



Description

With the DIO1 block the user can select whether DIO1 is used as a digital input or as a digital output and connect an actual signal to digital output 1. The block also shows the DIO status.

Inputs

12.01 DIO1 CONF

Selects whether DIO1 is used as a digital input or as a digital output.

0 = OUTPUT: Digital output

1 = INPUT: Digital input

12.04 DIO1 OUT PTR

Selects a drive signal to be connected to digital output DIO1 (when 12.01 DIO1 CONF is set to OUTPUT).

Bit pointer: Group, index and bit

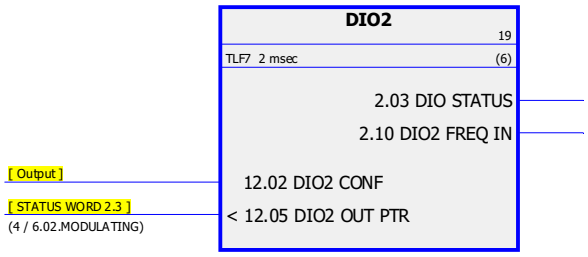
Outputs

2.03 DIO STATUS

Status word of digital inputs/outputs DIO1…3. Example: 001 = DIO1 is on, DIO2 and DIO3 are off.

DIO2

(19)



Description

With the DIO2 block the user can select whether DIO2 is used as a digital or frequency input or as a digital output and connect an actual signal to digital output 2. The block also shows the DIO status.

Frequency input can be scaled with standard function blocks. See chapter *Standard function blocks*.

Inputs

12.02 DIO2 CONF

Selects whether DIO2 is used as a digital input, as a digital output or as a frequency input.

0 = OUTPUT: Digital output

1 = INPUT: Digital input

2 = FREQ INPUT: Frequency input

12.05 DIO2 OUT PTR

Selects a drive signal to be connected to digital output DIO2 (when 12.02 DIO2 CONF is set to OUTPUT).

Bit pointer: Group, index and bit

Outputs

2.03 DIO STATUS

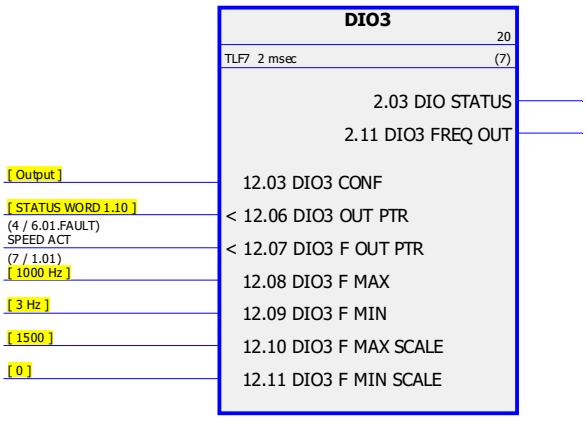
Status word of digital inputs/outputs DIO1…3. Example: 001 = DIO1 is on, DIO2 and DIO3 are off.

2.10 DIO2 FREQ IN

Frequency input value in Hz when DIO2 is used as frequency input (12.02 DIO2 CONF is set to FREQ INPUT).

DIO3

(20)



Description

With the DIO3 block the user can select whether DIO3 is used as a digital input or as a digital/frequency output, connect an actual signal to the digital/frequency output and scale the frequency output. The block also shows the DIO status.

Inputs

12.03 DIO3 CONF

Selects whether DIO3 is used as a digital input, as a digital output or as a frequency output.

0 = OUTPUT: Digital output

1 = INPUT: Digital input

3 = FREQ OUTPUT: Frequency output

12.06 DIO3 OUT PTR

Selects a drive signal to be connected to digital output DIO3 (when 12.03 DIO3 CONF is set to OUTPUT).

Bit pointer: Group, index and bit

12.07 DIO3 F OUT PTR

Selects a drive signal to be connected to frequency output (when 12.03 DIO3 CONF is set to FREQ OUTPUT).

Value pointer: Group and index

12.08 DIO3 F MAX

Defines the maximum value for frequency output (when 12.03 DIO3 CONF is set to FREQ OUTPUT).

Range: 3…32768 Hz

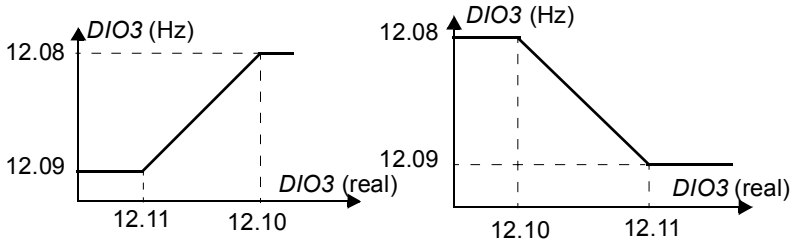
12.09 DIO3 F MIN

Defines the minimum value for frequency output (when 12.03 DIO3 CONF is set to FREQ OUTPUT).

Range: 3…32768 Hz

12.10 DIO3 F MAX SCALE

Defines the real value that corresponds to the maximum frequency output value defined by parameter 12.08 DIO3 F MAX.



Range: 0…32768

12.11 DIO3 F MIN SCALE

Defines the real value that corresponds to the minimum frequency output value defined by parameter 12.09 DIO3 F MIN.. See parameter 12.10 DIO3 F MAX SCALE.

Range: 0…32768

Outputs

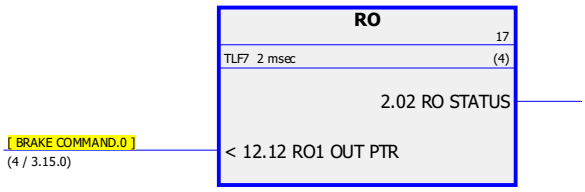
2.03 DIO STATUS

Status word of digital inputs/outputs DIO1…3. Example: 001 = DIO1 is on, DIO2 and DIO3 are off.

2.11 DIO3 FREQ OUT

Frequency output value in Hz when DIO3 is used as frequency output (12.03 DIO3 CONF is set to FREQ OUTPUT).

RO
(17)



Description

With the RO block the user can connect an actual signal to the relay output. The block also shows the relay output status.

Inputs

12.12 RO1 OUT PTR

Selects a drive signal to be connected to relay output RO1.
Bit pointer: Group, index and bit

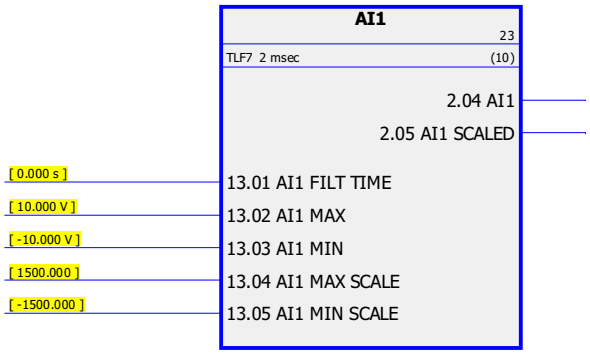
Outputs

2.02 RO STATUS

Status of relay output. 1 = RO is energized.

AI1

(23)



Description

With the AI1 block the user can filter and scale the analogue input 1 signal and select the AI1 supervision. The block also shows analogue input 1 value.

The drive offers two programmable analogue inputs, AI1 and AI2. Both inputs can be used either as a voltage or a current input (-11…11 V or -22…22 mA). The input type is selected with jumper J1 on the JCU Control Unit.

The inaccuracy of the analogue inputs is 1% of the full scale range and the resolution is 11 bits (+ sign). The hardware filter time constant is approximately 0.25 ms.

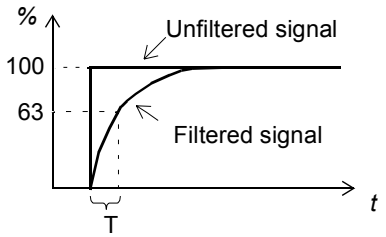
Analogue input can be used as the source for speed and torque reference.

Analogue input supervision can be added with standard function blocks. See chapter *Standard function blocks*.

Inputs

13.01 AI1 FILT TIME

Defines the filter time constant for analogue input AI1.



$O = I \cdot (1 - e^{-t/T})$

I = filter input (step)
O = filter output
t = time
T = filter time constant

Note: The signal is also filtered due to the signal interface hardware (approximately 0,25 ms time constant). This cannot be changed by any parameter.

Range: 0…30 s

13.02 AI1 MAX

Defines the maximum value for analogue input AI1. The type is selected with jumper J1 on the JCU Control Unit.

Range: -11…11 V / -22…22 mA

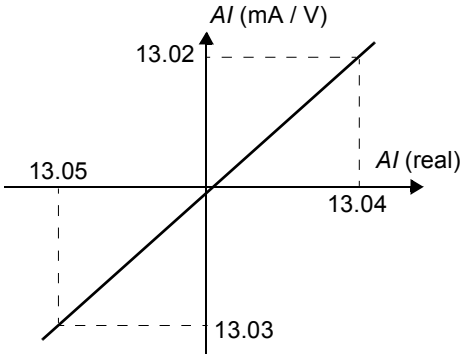
13.03 AI1 MIN

Defines the minimum value for analogue input AI1. The type is selected with jumper J1 on the JCU Control Unit.

Range: -11…11 V / -22…22 mA

13.04 AI1 MAX SCALE

Defines the real value that corresponds to the maximum analogue input value defined by parameter 13.02 AI1 MAX.



Range: -32768…32767

13.05 AI1 MIN SCALE

Defines the real value that corresponds to the minimum analogue input value defined by parameter 13.03 AI1 MIN. See parameter 13.04 AI1 MAX SCALE.

Range: -32768…32767

13.11 AITUNE

Triggers the AI tuning function.

Note: This parameter can only be accessed via the PC tool Parameter Browser.

Connect the signal to the input and select the appropriate tuning function.

0 = NO ACTION: AI tune is not activated.

1 = AI1 MIN TUNE: Current analogue input AI1 signal value is set as minimum value for AI1, parameter 13.03 AI1 MIN. The value reverts back to NO ACTION automatically.

2 = AI1 MAX TUNE: Current analogue input AI1 signal value is set as maximum value for AI1, parameter 13.02 AI1 MAX. The value reverts back to NO ACTION automatically.

3 = AI2 MIN TUNE: Current analogue input AI2 signal value is set as minimum value for AI2, parameter 13.08 AI2 MIN. The value reverts back to NO ACTION automatically

4 = AI2 MAX TUNE: Current analogue input AI2 signal value is set as maximum value for AI2, parameter 13.07 AI2 MAX. The value reverts back to NO ACTION automatically.

13.12 AI SUPERVISION

Selects how the drive reacts when analogue input signal limit is reached. The limit is selected by parameter 13.13 AI SUPERVIS ACT.

Note: This parameter can only be accessed via the PC tool Parameter Browser.

0 = NO: Inactive

1 = FAULT: The drive trips on fault AI SUPERVISION.

2 = SPD REF SAFE: The drive generates alarm AI SUPERVISION and sets the speed to the speed defined by parameter *46.02* SPEED REF SAFE.

WARNING! Make sure that it is safe to continue operation in case of a communication break.

3 = LAST SPEED: The drive generates alarm AI SUPERVISION and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds.

WARNING! Make sure that it is safe to continue operation in case of a communication break.

13.13 AI SUPERVIS ACT

Selects the analogue input signal supervision limit.

Note: This parameter can only be accessed via the PC tool Parameter Browser.

Bit		Supervision selected by parameter 13.12 AI SUPERVISION is activated if
0	AI1<min	AI1 signal value falls below the value defined by equation: par. 13.03 AI1 MIN - 0.5 mA or V
1	AI1>max	AI1 signal value exceeds the value defined by equation: par. 13.02 AI1 MAX + 0.5 mA or V
2	AI2<min	AI2 signal value falls below the value defined by equation: par. 13.08 AI2 MIN - 0.5 mA or V
3	AI2>min	AI1 signal value exceeds the value defined by equation: par. 13.07 AI2 MAX + 0.5 mA or V

Example: If parameter value is set to 0010 (bin), bit 1 AI1>max is selected.

Outputs

2.04 AI1

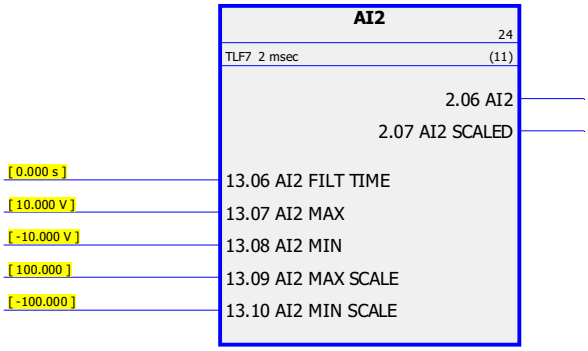
Analogue input AI1 value in V or mA. The type is selected with jumper J1 on the JCU Control Unit.

2.05 AI1 SCALED

Scaled value of analogue input AI1. See parameters 13.04 AI1 MAX SCALE and 13.05 AI1 MIN SCALE.

AI2

(24)



Description

With the AI2 block the user can filter and scale the analogue input 2 signal and select the AI2 supervision. The block also shows analogue input 2 value.

See also description in firmware block *AI1* on page *55*.

Inputs

13.06 AI2 FILT TIME

Defines the filter time constant for analogue input AI2. See parameter 13.01 AI1 FILT TIME.

Range: 0…30 s

13.07 AI2 MAX

Defines the maximum value for analogue input AI2. The type is selected with jumper J2 on the JCU Control Unit.

Range: -22…22 mA / -11…11 V

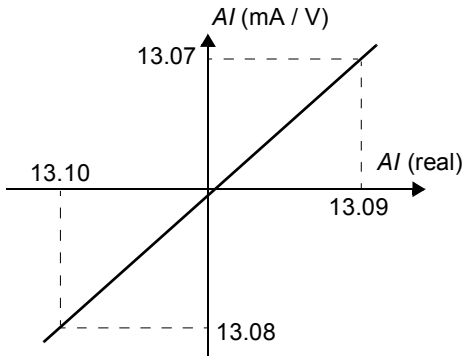
13.08 AI2 MIN

Defines the minimum value for analogue input AI2. The type is selected with jumper J2 on the JCU Control Unit.

Range: -22…22 mA / -11…11 V

13.09 AI2 MAX SCALE

Defines the real value that corresponds to the maximum analogue input value defined by parameter 13.07 AI2 MAX.



Range: -32768…32767

13.10 AI2 MIN SCALE

Defines the real value that corresponds to the minimum analogue input value defined by parameter 13.08 AI2 MIN. See parameter 13.09 AI2 MAX SCALE.

Range: -32768…32767

13.11 AITUNE

Triggers the AI tuning function. For selections, see firmware block *AI1* on page *55*.

Note: This parameter can only be accessed via the PC tool Parameter Browser.

13.12 AI SUPERVISION

Selects how the drive reacts when analogue input signal limit is reached. The limit is selected by parameter 13.13 AI SUPERVIS ACT. For selections, see firmware block *AI1* on page *55*.

Note: This parameter can only be accessed via the PC tool Parameter Browser.

13.13 AI SUPERVIS ACT

Selects the analogue input signal supervision limit. For selections, see firmware block *AI1* on page *55*.

Note: This parameter can only be accessed via the PC tool Parameter Browser.

Outputs

2.06 AI2

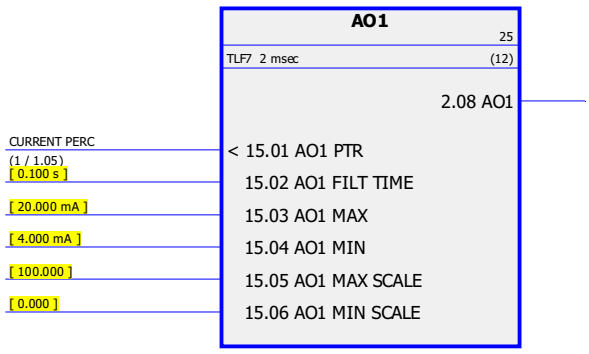
Analogue input AI2 value in V or mA. The type is selected with jumper J2 on the JCU Control Unit.

2.07 AI2 SCALED

Scaled value of analogue input AI2. See parameters 13.09 AI2 MAX SCALE and 13.10 AI2 MIN SCALE.

AO1

(25)



Description

With the AO1 block the user can connect an actual signal to analogue output 1 and filter and scale the output signal. The block also shows analogue output 1 value.

The drive offers two programmable analogue outputs: one current output AO1 (0…20 mA) and one voltage output AO2 (-10…10 V).

The resolution of the analogue outputs is 11 bits (+ sign) and the inaccuracy is 2% of the full scale range.

The analogue output signals can be proportional to motor speed, process speed (scaled motor speed), output frequency, output current, motor torque, motor power, etc. It is possible to write a value to an analogue output through a serial communication link (e.g. fieldbus link).

Inputs

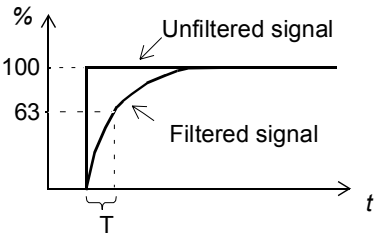
15.01 AO1 PTR

Selects a drive signal to be connected to analogue output AO1.

Value pointer: Group and index

15.02 AO1 FILT TIME

Defines the filtering time constant for analogue output AO1.



$O = I \cdot (1 - e^{-t/T})$

I = filter input (step)
O = filter output
t = time
T = filter time constant

Note: The signal is also filtered due to the signal interface hardware (approximately 0,5 ms time constant). This cannot be changed by any parameter.

Range: 0…30 s

15.03 AO1 MAX

Defines the maximum value for analogue output AO1.

Range: 0…22.7 mA

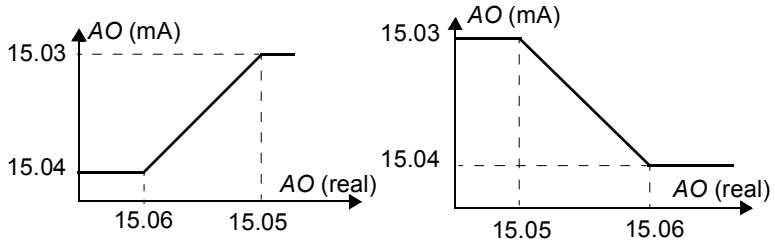
15.04 AO1 MIN

Defines the minimum value for analogue output AO1.

Range: 0…22.7 mA

15.05 AO1 MAX SCALE

Defines the real value that corresponds to the maximum analogue output value defined by parameter 15.03 AO1 MAX.



Range: -32768…32767

15.06 AO1 MIN SCALE

Defines the real value that corresponds to the minimum analogue output value defined by parameter 15.04 AO1 MIN. See parameter 15.05 AO1 MAX SCALE.

Range: -32768…32767

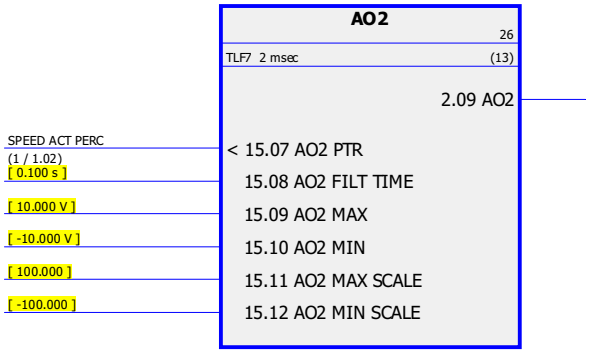
Outputs

2.08 AO1

Analogue output AO1 value in mA

AO2

(26)



Description

With the AO2 block the user can connect an actual signal to analogue output 2 and filter and scale the output signal. The block also shows analogue output 1 value.

See also description in firmware block *AO1* on page *60*.

Inputs

15.07 AO2 PTR

Selects a drive signal to be connected to analogue output AO2.
Value pointer: Group and index

15.08 AO2 FILT TIME

Defines the filtering time constant for analogue output AO1. See parameter 15.02 AO1 FILT TIME.
Range: 0…30 s

15.09 AO2 MAX

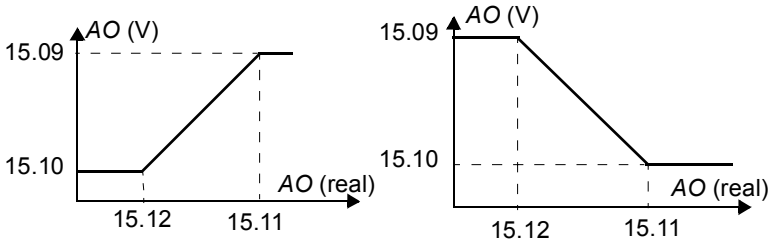
Defines the maximum value for analogue output AO2.
Range: -10…10 V

15.10 AO2 MIN

Defines the minimum value for analogue output AO2.
Range: -10…10 V

15.11 AO2 MAX SCALE

Defines the real value that corresponds to the maximum analogue output value defined by parameter 15.09 AO2 MAX.



Range: -32768…32767

15.12 AO2 MIN SCALE

Defines the real value that corresponds to the minimum analogue output value defined by parameter 15.10 AO2 MIN. See parameter 15.11 AO2 MAX SCALE.

Range: -32768…32767

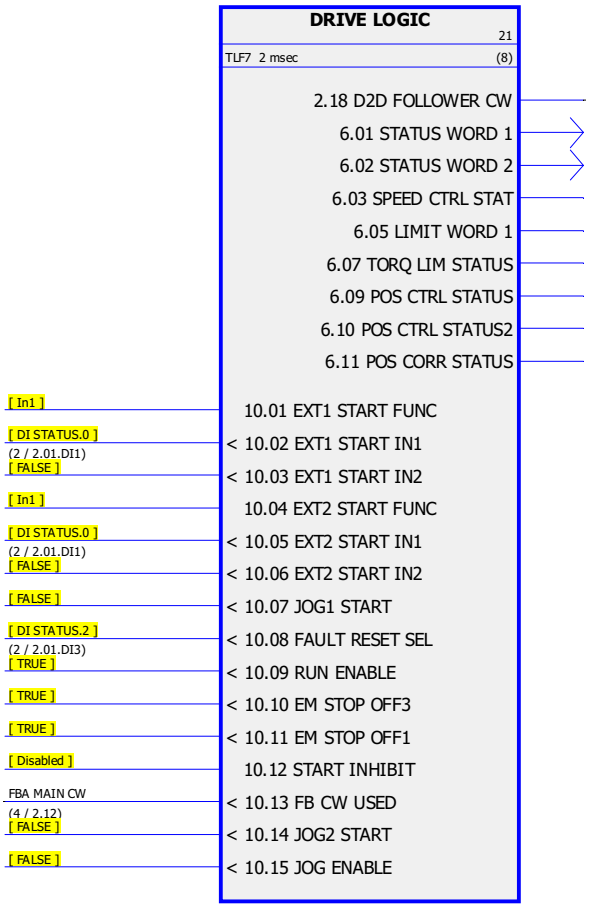
Outputs

2.09 AO2

Analogue output AO12 value in V

DRIVE LOGIC

(21)



Description

With the DRIVE LOGIC block the user can

- select the source for the start and stop commands in external control location EXT1/2.
- select the sources for external fault reset and run enable signals.
- select the source for the emergency stop (OFF1 and OFF3).
- select the source for the jogging function activation signal.
- enable the start inhibit function.

Note: The run enable signal must be active for the drive to start.

The block also shows the status and limit words of the drive.

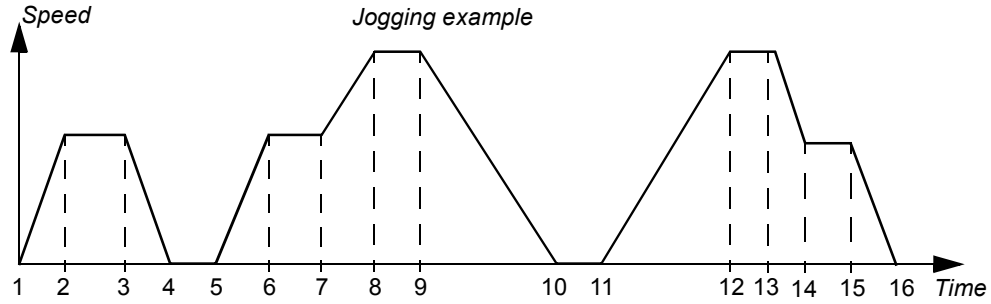
Jogging

Two jogging functions (1 or 2) are available. When a jogging function is activated, the drive starts and accelerates to the defined jogging speed along the defined jogging acceleration ramp. When the function is deactivated, the drive decelerates to a stop along the defined jogging deceleration ramp. One push button can be used to

start and stop the drive during jogging. The jogging function is typically used during servicing or commissioning to control the machinery locally.

Jogging functions 1 and 2 are activated by a parameter or through fieldbus. For activation through fieldbus, see 2.12 FBA MAIN CW.

The figure and table below describe the operation of the drive during jogging. (Note that they cannot be directly applied to jogging commands through fieldbus as those require no enable signal; see parameter 10.15 JOG ENABLE.) They also represent how the drive shifts to normal operation (= jogging inactive) when the drive start command is switched on. Jog cmd = State of the jogging input; Jog enable = Jogging enabled by the source set by parameter 10.15 JOG ENABLE; Start cmd = State of the drive start command.



Phase	Jog cmd	Jog enable	Start cmd	Description
1-2	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	1	0	Drive runs at the jogging speed.
3-4	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	1	0	Drive is stopped.
5-6	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	1	0	Drive runs at the jogging speed.
7-8	x	0	1	Jog enable is not active; normal operation continues.
8-9	x	0	1	Normal operation overrides the jogging. Drive follows the speed reference.
9-10	x	0	0	Drive decelerates to zero speed along the active deceleration ramp.
10-11	x	0	0	Drive is stopped.
11-12	x	0	1	Normal operation overrides the jogging. Drive accelerates to the speed reference along the active acceleration ramp.
12-13	1	1	1	Start command overrides the jog enable signal.
13-14	1	1	0	Drive decelerates to the jogging speed along the deceleration ramp of the jogging function.
14-15	1	1	0	Drive runs at the jogging speed.
15-16	x	0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

Note: Jogging is not operational when:

- the drive start command is on, or
- the drive is in local control.

Note: The ramp shape time is set to zero during jogging.

Emergency stop

Note: The user is responsible for installing the emergency stop devices and all the additional devices needed for the emergency stop to fulfil the required emergency stop category classes. For more information, contact your local ABB representative.

The emergency stop signal is connected to the digital input which is selected as the source for the emergency stop activation (par. 10.10 EM STOP OFF3 or 10.11 EM STOP OFF1). Emergency stop can also be activated through fieldbus (2.12 FBA MAIN CW).

Note: When an emergency stop signal is detected, the emergency stop function cannot be cancelled even though the signal is cancelled.

Inputs

10.01 EXT1 START FUNC

Selects the source for the start and stop control in external control location 1 (EXT1).

Note: This parameter cannot be changed while the drive is running.

1 = IN1: Source of the start and stop commands are selected by parameter 10.02 EXT1 START IN1. The start/stop is controlled as follows:

Par. 10.02	Command
0 -> 1	Start
1 -> 0	Stop

2 = 3-WIRE: Source of the start and stop commands are selected by parameters 10.02 EXT1 START IN1 and 10.03 EXT1 START IN2. The start/stop is controlled as follows:

Par. 10.02	Par. 10.03	Command
0 -> 1	1	Start
Any	1 -> 0	Stop
Any	0	Stop

3 = FBA: Start and stop control from the source selected by parameter 10.13 FB CW USED.

4 = D2D: Start and stop control from another drive via D2D Control Word.

10.02 EXT1 START IN1

Selects the source 1 for the start and stop commands in external control location EXT1. See parameter 10.01 EXT1 START FUNC selections IN1 and 3-WIRE.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.03 EXT1 START IN2

Selects the source 2 for the start and stop commands in external control location EXT1. See parameter 10.01 EXT1 START FUNC selection 3-WIRE.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.04 EXT2 START FUNC

Selects the source for the start and stop control in external control location 2 (EXT2).

Note: This parameter cannot be changed while the drive is running.

1 = IN1: Source of the start and stop commands are selected by parameter 10.05 EXT2 START IN1. The start/stop is controlled as follows:

Par. 10.05	Command
0 -> 1	Start
1 -> 0	Stop

2 = 3-WIRE: Source of the start and stop commands are selected by parameters 10.05 EXT2 START IN1 and 10.06 EXT2 START IN2. The start/stop is controlled as follows:

Par. 10.05	Par. 10.06	Command
0 -> 1	1	Start
Any	1 -> 0	Stop
Any	0	Stop

3 = FBA: Start and stop control from the source selected by parameter 10.13 FB CW USED.

4 = D2D: Start and stop control from another drive via D2D Control Word.

10.05 EXT2 START IN1

Selects the source 1 for the start and stop commands in external control location EXT2. See parameter 10.04 EXT2 START FUNC selections IN1 and 3-WIRE.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.06 EXT2 START IN2

Selects the source 2 for the start and stop commands in external control location EXT2. See parameter 10.04 EXT2 START FUNC selection 3-WIRE.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.07 JOG1 START

If enabled by parameter 10.15 JOG ENABLE, selects the source for the activation of jogging function 1. 1 = Active. (Jogging function 1 can also be activated through fieldbus regardless of parameter 10.15.)

See also other jogging function parameters: 10.14 JOG2 START, 10.15 JOG ENABLE, 24.03 SPEED REF1 IN / 24.04 SPEED REF2 IN, 24.10 SPEED REF JOG1, 24.11 SPEED REF JOG2, 25.09 ACC TIME JOGGING, 25.10 DEC TIME JOGGING and 22.06 ZERO SPEED DELAY.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.08 FAULT RESET SEL

Selects the source for the external fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 1 = Fault reset.

Bit pointer: Group, index and bit

10.09 RUN ENABLE

Selects the source for the external run enable signal. If run enable signal is switched off, the drive will not start or stops if the drive is running. 1 = Run enable.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.10 EM STOP OFF3

Selects the source for the emergency stop OFF3. 0 = OFF3 active: The drive is stopped along the emergency stop ramp time, 25.11 EM STOP TIME.

Emergency stop can also be activated through fieldbus (2.12 FBA MAIN CW).

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.11 EM STOP OFF1

Selects the source for the emergency stop OFF1. 0 = OFF1 active: The drive is stopped with the active deceleration time.

Emergency stop can also be activated through fieldbus (2.12 FBA MAIN CW).

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.12 START INHIBIT

Enables the start inhibit function. The start inhibit function prevents drive restart (i.e. protects against unexpected start) if

- drive trips on a fault and fault is reset.
- run enable signal activates while the start command is active. See parameter 10.09 RUN ENABLE.
- control changes from local to remote.
- external control switches from EXT1 to EXT2 or from EXT2 to EXT1.

An active start inhibit can be reset with a stop command.

Note that in certain applications it is necessary to allow the drive to restart.

0 = DISABLED

1 = ENABLED

10.13 FB CW USED

Selects the source for the control word when fieldbus (FBA) is selected as the external start and stop control location (see parameters 10.01 and 10.04). By default, the source is parameter *2.12* FBA MAIN CW.

Note: This parameter cannot be changed while the drive is running.

Value pointer: Group and index

10.14 JOG2 START

If enabled by parameter 10.15 JOG ENABLE, selects the source for the activation of jogging function 2. 1 = Active. (Jogging function 2 can also be activated through fieldbus regardless of parameter 10.15.)

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

10.15 JOG ENABLE

Selects the source for enabling parameters 10.07 JOG1 START and 10.14 JOG2 START.

Note: Jogging can be enabled using this parameter only when no start command from an external control location is active. On the other hand, if jogging is already enabled, the drive cannot be started from an external control location apart from jog commands through fieldbus.

Bit pointer: Group, index and bit

Outputs

2.18 D2D FOLLOWER CW

Drive-to-drive control word sent to the followers by default. See also firmware block D2D COMMUNICATION on page 160.

Bit	Information
0	Stop.
1	Start.
2…6	Reserved.
7	Run enable.
8	Reset.
9…14	Reserved.
15	EXT1/EXT2 selection. 0 = EXT1 active, 1 = EXT2 active.

6.01 STATUS WORD 1

Status Word 1

Bit	Name	Val.	Information
0	READY	1	Drive is ready to receive start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal is received.
		0	No external run enable signal is received.
2	STARTED	1	Drive has received start command.
		0	Drive has not received start command.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	EM OFF (OFF2)	1	Emergency OFF2 is active.
		0	Emergency OFF2 is inactive.
5	EM STOP (OFF3)	1	Emergency stop OFF3 (ramp stop) is active.
		0	Emergency OFF3 is inactive.
6	ACK STARTINH	1	Start inhibit is active.
		0	Start inhibit is inactive.
7	ALARM	1	Alarm is active. See chapter Fault tracing.
		0	No alarm
8	EXT2 ACT	1	External control EXT2 is active.
		0	External control EXT1 is active.
9	LOCAL FB	1	Fieldbus local control is active.
		0	Fieldbus local control is inactive.
10	FAULT	1	Fault is active. See chapter Fault tracing.
		0	No fault
11	LOCAL PANEL	1	Local control is active, i.e. drive is controlled form PC tool or control panel.
		0	Local control is inactive.
12 … 15	Not in use		

6.02 STATUS WORD 2

Status Word 2.

Bit	Name	Val.	Information
0	START ACT	1	Drive start command is active.
		0	Drive start command is inactive.
1	STOP ACT	1	Drive stop command is active.
		0	Drive stop command is inactive.
2	READY RELAY	1	Ready to function: run enable signal on, no fault, emergency stop signal off, no ID run inhibition. Connected as default to DIO1 by par. 12.04 DIO1 OUT PTR. (Can be freely connected anywhere.)
		0	Not ready to function
3	MODULATING	1	Modulating: IGBTs are controlled, i.e. the drive is RUNNING.
		0	No modulation: IGBTs are not controlled.
4	REF RUNNING	1	Normal operation is enabled. Running. Drive follows the given reference.
		0	Normal operation is disabled, Drive is not following the given reference (e.g. in magnetisation phase drive is modulating).
5	JOGGING	1	Jogging function 1 or 2 is active.
		0	Jogging function is inactive.
6	OFF1	1	Emergency stop OFF1 is active.
		0	Emergency stop OFF1 is inactive.
7	START INH MASK	1	Maskable (by par. 10.12 START INHIBIT) start inhibit is active.
		0	No start inhibit (maskable)
8	START INH NOMASK	1	Non-maskable start inhibit is active.
		0	No start inhibit (non-maskable)
9	CHRG REL CLOSED	1	Charging relay is closed.
		0	Charging relay is open.
10	STO ACT	1	Safe Torque Off function is active. See parameter 46.07 STO DIAGNOSTIC.
		0	Safe Torque Off function is inactive.
11	Not in use		
12	RAMP IN 0	1	Ramp Function Generator input is forced to zero.
		0	Normal operation
13	RAMP HOLD	1	Ramp Function Generator output is held.
		0	Normal operation
14	RAMP OUT 0	1	Ramp Function Generator output is forced to zero.
		0	Normal operation
15	Not in use		

6.03 SPEED CTRL STAT

Speed control status word

Bit	Name	Val.	Information
0	SPEED ACT NEG	1	Actual speed is negative.
1	ZERO SPEED	1	Actual speed has reached the zero speed limit (22.05 ZERO SPEED LIMIT).
2	ABOVE LIMIT	1	Actual speed has exceeded the supervision (22.07 ABOVE SPEED LIM).
3	AT SETPOINT	1	The difference between the actual speed and the unramped speed reference is within the speed window (26.07 SPEED WINDOW).
4	BAL ACTIVE	1	Speed controller output balancing is active (28.09 SPEEDCTRL BAL EN).

6.05 LIMIT WORD 1

Limit Word 1

Bit	Name	Val.	Information
0	TORQ LIM	1	Drive torque is being limited by the motor control (undervoltage control, overvoltage control, current control, load angle control or pull-out control), or by parameter 20.06 MAXIMUM TORQUE or 20.07 MINIMUM TORQUE.
1	SPD CTL TLIM MIN	1	Speed controller output minimum torque limit is active. The limit is defined by parameter 28.10 MIN TORQ SP CTRL.
2	SPD CTL TLIM MAX	1	Speed controller output maximum torque limit is active. The limit is defined by parameter 28.11 MAX TORQ SP CTRL.
3	TORQ REF MAX	1	Torque reference (3.09 TORQ REF1) maximum limit is active. The limit is defined by parameter 32.04 MAXIMUM TORQ REF.
4	TORQ REF MIN	1	Torque reference (3.09 TORQ REF1) minimum limit is active. The limit is defined by parameter 32.05 MINIMUM TORQ REF.
5	TLIM MAX SPEED	1	Torque reference maximum value is limited by the rush control, because of maximum speed limit 20.01 MAXIMUM SPEED.
6	TLIM MIN SPEED	1	Torque reference minimum value is limited by the rush control, because of minimum speed limit 20.02 MINIMUM SPEED.

6.07 TORQ LIM STATUS

Torque controller limitation status word

Bit	Name	Val.	Information
0	UNDERVOLTAGE	1	Intermediate circuit DC undervoltage
1	OVERVOLTAGE	1	Intermediate circuit DC overvoltage
2	MINIMUM TORQUE	1	Torque reference minimum limit is active. The limit is defined by parameter 20.07 MINIMUM TORQUE.
3	MAXIMUM TORQUE	1	Torque reference maximum limit is active. The limit is defined by parameter 20.06 MAXIMUM TORQUE.
4	INTERNAL CURRENT	1	Inverter output current limit is active. Bit 8/9/10 shows which current limit is active.*
5	LOAD ANGLE	1	For permanent magnet motor only: Load angle limit is active, i.e. the motor cannot produce more torque.
6	MOTOR PULLOUT	1	For asynchronous motor only: Motor pull-out limit is active, i.e. the motor cannot produce more torque.
7	Reserved		
8	SOA CURRENT	1	Internal Safe Operating Area current limit is active (limits the drive output current). *
9	USER CURRENT	1	Maximum inverter output current limit is active. The limit is defined by parameter 20.05 MAXIMUM CURRENT.*
10	INVERTER THERMAL	1	Calculated thermal current value limits the inverter output current. Thermal current limitation is enabled by parameter 20.08 THERM CURR LIM.*
* Bit 8…10: The smallest limit value is selected, thus one of the bits 8…10 is always active. If bit 4 value is 0, there is no inverter output current limitation, even though bit 8/9/10 value is 1.			

6.09 POS CTRL STATUS

Position control status word. **Note:** This signal is only for positioning applications.

Bit	Name	Val.	Information
0	IN POSITION	1	Position reference generator has reached the used position reference.
		0	Position reference generator is calculating the position reference.
1	IN POS WIN	1	Position is within the defined position window, 66.04 POS WIN.
		0	Position reference is outside the defined position window.
2	POS START	1	Positioning start command is active. Source for the start signal is selected by parameter 65.03 POS START 1 / 65.11 POS START 2.
		0	Position start command is inactive.
3	POS ENA-BLED	1	Position control is enabled by parameter 66.05 POS ENABLE or by fieldbus control word 2.12 FBA MAIN CW bit 21.
		0	Position control is not enabled.
4	MOVING	1	Positioning task is active. Drive speed is < > 0.
		0	Positioning task is completed or drive is at standstill.
5	TRAVERSE ACK	1	New positioning task or setpoint is accepted.
		0	No operation
6	IP MODE ACT	1	Position reference generator is active.
		0	Position reference generator is inactive.
7	FOLLOW ERR	1	The difference between the reference and the actual position is within the defined following error window 71.09 FOLLOW ERR WIN.
		0	The difference between the reference and the actual position is outside the defined following error window.
8	ABOVE MAX	1	Actual position (1.12 POS ACT) exceeds the defined maximum position, 60.13 MAXIMUM POS.
		0	Actual position does not exceed the maximum value.
9	BELOW MIN	1	Actual position (1.12 POS ACT) exceeds the defined minimum position, 60.14 MINIMUM POS.
		0	Actual position does not exceed the minimum value.
10	ABOVE THRES	01	Actual position (1.12 POS ACT) exceeds the position threshold supervision limit. The limit is defined by parameter 60.15 POS THRESHOLD.
		0	Actual position does not exceed the position threshold supervision limit.
11	Not in use		
12	PREF SPD LIM	1	Position reference speed is limited to the value defined by parameter 70.04 POS SPEED LIM.
		0	Position reference speed is not limited.
13	PREF ACC LIM	1	Position reference acceleration is limited to the value defined by parameter 70.05 POS ACCEL LIM.
		0	Position reference acceleration is not limited.
14	PREF DEC LIM	1	Position reference deceleration is limited to the value defined by parameter 70.06 POS DECEL LIM.
		0	Position reference deceleration is not limited.
15	Reserved		

6.10 POS CTRL STATUS2

Additional position control status word. **Note:** This signal is only for positioning applications.

Bit	Name	Val.	Information
0	IN SYNC POS	1	Position profile generator distance to target is below the absolute value of the synchron error limit, i.e. value of actual signal 4.14 is smaller than value of parameter 70.07.
		0	Distance to target is greater than synchron error limit.
1	IN SYNC	1	The difference of synchronous speed and drive load speed (4.02 SPEED ACT LOAD) is below the defined velocity window (70.08 SYNC VEL WINDOW).
		0	The system is not in synchron as defined by the synchron velocity window (70.08 SYNC VEL WINDOW).
2	END SPEED ACTIVE	1	Positioning end speed (defined by parameter 65.10 or 65.18 depending on selected position reference set) has been reached.
		0	Positioning end speed has not been reached or end speed is defined as zero.
3	Reserved		
…	…		
15	Reserved		

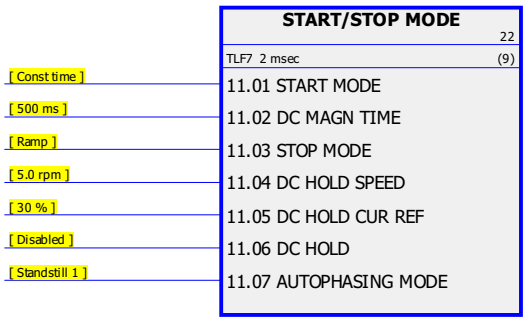
6.11 POS CORR STATUS

Position correction status word. **Note:** This signal is only for positioning applications.

Bit	Name	Val.	Information
0	HOMING START	1	Homing start is active. Source for the homing start is selected by parameter 62.03 HOMING START.
		0	Homing start is inactive.
1	HOMING DONE	1	Homing has been performed.
		0	Homing has not been performed (if bit 2 = 0) or homing is being executed.
2	HOM DONE ONCE	1	Homing has been performed at least once.
		0	Homing has not been performed after power up or there is an error with the actual position encoder.
3	COR DONE ONCE	1	Cyclic correction has been performed at least once (62.14 CYCLIC CORR MODE).
		0	Cyclic correction has not been performed after power up or there is an error with the actual position encoder.
4	POS LIM POS	1	Positive limit switch is active (source selected by parameter 62.06 POS LIM SWITCH).
		0	Positive limit switch is inactive.
5	POS LIM NEG	1	Negative limit switch is active (source selected by parameter 62.05 NEG LIM SWITCH).
		0	Negative limit switch is inactive.
6	LATCH1 STAT	1	Position latch signal 1 is active (source selected by parameter 62.15 TRIG PROBE1).
		0	Position latch signal 1 is inactive.
7	LATCH2 STAT	1	Position latch signal 2 is active (source selected by parameter 62.17 TRIG PROBE2).
		0	Position latch signal 2 is inactive.
8	LATCH1 DONE	1	Position has been latched according to parameter 62.15 TRIG PROBE1 setting.
		0	No position latch has occurred.
9	LATCH2 DONE	1	Position has been latched according to parameter 62.17 TRIG PROBE2 setting
		0	No position latch has occurred.
10	Reserved		
11	Reserved		
12	CYC CORR ACTIV	1	Cyclic correction is active.
		0	Cyclic correction is inactive.
13	Reserved		
…	…		
15	Reserved		

START/STOP MODE

(22)



Description

With the START/STOP MODE block the user can select the start and stop functions, define the DC magnetising time of the motor and configure the DC hold function.

Automatic start

Since the drive can detect the state of the motor within a few milliseconds, the starting is immediate under all conditions. There is no restart delay. E.g. the starting of high inertia applications is easy. Automatic start is especially suitable for restarting a rotating machine.

DC Magnetising

When DC Magnetising is activated, the drive automatically magnetises the motor before starting. This feature guarantees the highest possible breakaway torque, up to 200% of the motor nominal torque depending on the existing current limit settings. By adjusting the premagnetising time, it is possible to synchronise the motor start and e.g. a mechanical brake release. The automatic start feature and DC magnetising cannot be activated at the same time.

DC hold

By activating the motor DC hold feature it is possible to lock the rotor at zero speed. When both the reference and the motor speed fall below the preset DC hold speed, the drive stops the motor and starts to inject DC into the motor. When the reference speed again exceeds the DC hold speed, the normal drive operation resumes.

DC hold can be activated only in the speed control mode.

Inputs

11.01 START MODE

Selects the motor start function.

Note: Selections FAST and CONST TIME are ignored if parameter 99.05 MOTOR CTRL MODE = SCALAR.

Note: Starting to a rotating machine is not possible when DC magnetising is selected (FAST or CONST TIME).

Note: With permanent magnet motors, automatic start must be used.

0 = FAST: DC magnetising should be selected if a high break-away torque is required. The drive pre-magnetises the motor before the start. The pre-magnetising time is determined automatically, being typically 200 ms to 2 s depending on the motor size.

Note: This parameter cannot be changed while the drive is running.

1 = CONST TIME: Constant DC magnetising should be selected instead of DC magnetising if constant pre-magnetising time is required (e.g. if the motor start must be simultaneous with a mechanical brake release). This selection also guarantees the highest possible break-away torque when the pre-magnetising time is set long enough. The pre-magnetising time is defined by parameter 11.02 DC MAGN TIME.

WARNING! The drive will start after the set magnetising time has passed although the motor magnetisation is not completed. Ensure always in applications where a full break-away torque is essential, that the constant magnetising time is long enough to allow generation of full magnetisation and torque.

2 = AUTOMATIC: Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting to a rotating machine) and the automatic restart function (stopped motor can be restarted immediately without waiting the motor flux to die away). The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions. **Note:** If parameter 99.05 MOTOR CTRL MODE = SCALAR, no flying start or automatic restart is possible by default.

11.02 DC MAGN TIME

Defines the constant DC magnetising time. See parameter 11.01 START MODE. After the start command, the drive automatically premagnetises the motor the set time.

To ensure full magnetising, set this value to the same value as or higher than the rotor time constant. If not known, use the rule-of-thumb value given in the table below:

Motor rated power	Constant magnetising time
< 1 kW	≥ 50 to 100 ms
1 to 10 kW	≥ 100 to 200 ms
10 to 200 kW	≥ 200 to 1000 ms
200 to 1000 kW	≥ 1000 to 2000 ms

Note: This parameter cannot be changed while the drive is running.

Range: 0…10000 ms

11.03 STOP MODE

Selects the motor stop function.

1 = COAST: Stop by cutting of the motor power supply. The motor coasts to a stop.

WARNING! If the mechanical brake is used, ensure it is safe to stop the drive by coasting. For more information on mechanical brake function, see firmware block MECH BRAKE CTRL on page *118*.

2 = RAMP: Stop along ramp. See firmware block SPEED REF RAMP on page *97*.

11.04 DC HOLD SPEED

Defines the DC hold speed. See parameter 11.06 DC HOLD.

Range: 0…1000 rpm

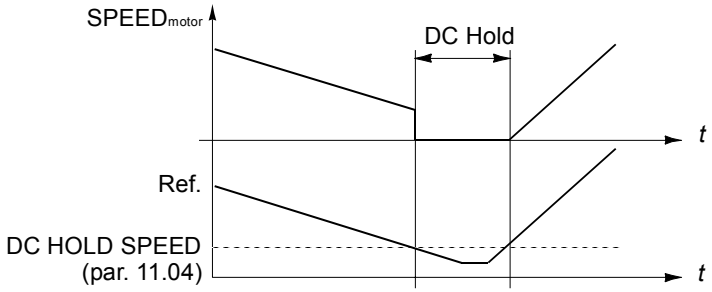
11.05 DC HOLD CUR REF

Defines the DC hold current in percent of the motor nominal current. See parameter 11.06 DC HOLD.

Range: 0…100%

11.06 DC HOLD

Enables the DC hold function. DC hold is not possible if par. 99.05 MOTOR CTRL MODE is set to SCALAR. When both the reference and the speed drop below the value of parameter 11.04 DC HOLD SPEED, the drive will stop generating sinusoidal current and start to inject DC into the motor. The current is set by parameter 11.05 DC HOLD CUR REF. When the reference speed exceeds parameter 11.04 DC HOLD SPEED, normal drive operation continues.



Note: DC Hold has no effect if the start signal is switched off.

Note: Injecting DC current into the motor causes the motor to heat up. In applications where long DC hold times are required, externally ventilated motors should be used. If the DC hold period is long, the DC hold cannot prevent the motor shaft from rotating if a constant load is applied to the motor.

0 = DISABLED

1 = ENABLED

11.07 AUTOPHASING MODE

Selects the way autophasing is performed during the ID run.

0 = TURNING: This mode gives the most accurate autophasing result. This mode can be used, and is recommended, if it is allowed for the motor to rotate during the ID run and the start-up is not time-critical. **Note:** This mode will cause the motor to rotate during the ID run.

1 = STANDSTILL 1: Faster than the TURNING mode, but not as accurate. The motor will not rotate.

2 = STANDSTILL 2: An alternative standstill autophasing mode that can be used if the TURNING mode cannot be used, and the STANDSTILL 1 mode gives erratic results. However, this mode is considerably slower than STANDSTILL 1.

SYSTEM

Note: The SYSTEM parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

With the SYSTEM parameters the user can disable local control and parameter changing, restore parameter default values and save parameters into permanent memory.

Parameters

16.01 LOCAL LOCK

Selects the source for disabling local control (Take/Release button on the PC tool, LOC/REM key of the panel). 1 = Local control disabled. 0 = Local control enabled.

WARNING! Before activating, ensure that the control panel is not needed for stopping the drive!

Bit pointer: Group, index and bit

16.02 PARAMETER LOCK

Selects the state of the parameter lock. The lock prevents parameter changing.

Note: This parameter can only be adjusted after the correct pass code has been entered at parameter 16.03 PASS CODE.

0 = LOCKED: Locked. Parameter values cannot be changed from the control panel.

1 = OPEN: The lock is open. Parameter values can be changed.

2 = NOT SAVED: The lock is open. Parameter values can be changed, but the changes will not be stored at power switch off.

16.03 PASS CODE

After entering 358 at this parameter, parameter 16.02 PARAMETER LOCK can be adjusted.

The value reverts back to 0 automatically.

16.04 PARAM RESTORE

Restores the original settings of the application, i.e. parameter factory default values.

Note: This parameter cannot be changed while the drive is running.

0 = DONE: Restoring is completed.

1 = RESTORE DEFS: All parameter values are restored to default values, except motor data, ID run results and fieldbus and encoder configuration data.

2 = CLEAR ALL: All parameter values are restored to default values, including motor data, ID run results and fieldbus and encoder configuration data. PC tool communication is interrupted during the restoring. Drive CPU is re-booted after the restoring is completed.

16.07 PARAM SAVE

Saves the valid parameter values to the permanent memory. **Note:** A new parameter value is saved automatically when changed from the PC tool or panel but not when altered through a fieldbus connection.

0 = DONE: Saving completed.

1 = SAVE: Saving in progress.

16.09 USER SET SEL

Enables the saving and restoring of up to four custom sets of parameter settings.

The set that was in use before powering down the drive is in use after the next power-up.

Note: Any parameter changes made after loading a set are not automatically stored – they must be saved using this parameter.

1 = NO REQUEST: Load or save operation complete; normal operation.

2 = LOAD SET 1: Load user parameter set 1.

3 = LOAD SET 2: Load user parameter set 2.

4 = LOAD SET 3: Load user parameter set 3.

5 = LOAD SET 4: Load user parameter set 4.

6 = SAVE SET 1: Save user parameter set 1.

7 = SAVE SET 2: Save user parameter set 2.

8 = SAVE SET 3: Save user parameter set 3.

9 = SAVE SET 4: Save user parameter set 4.

10 = IO MODE: Load user parameter set using parameters 16.11 and 16.12.

16.10 USER SET LOG

Shows the status of the user parameter sets (see parameter 16.09). Read-only.

N/A: No user sets have been saved.

FAULTED: Invalid or empty parameter set.

SETx PAR ACT: User parameter set x has been loaded using parameter 16.09.

SETx IO ACT: User parameter set x has been selected by parameters 16.11 and 16.12.

16.11 USER IO SET LO

Together with parameter 16.12, selects the user parameter set when parameter 16.12 is set to IO MODE. The status of the source defined by this parameter and parameter 16.12 select the user parameter set as follows:

Status of source defined by par. 16.11	**Status of source defined by par. 16.12**	**User parameter set selected**
FALSE	FALSE	Set 1
TRUE	FALSE	Set 2
FALSE	TRUE	Set 3
TRUE	TRUE	Set 4

Bit pointer: Group, index and bit

16.12 USER IO SET HI

See parameter 16.11.

Bit pointer: Group, index and bit

PANEL DISPLAY

Note: The PANEL DISPLAY parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

With the PANEL DISPLAY parameters the user can select the three signals to be displayed on the control panel.

Parameters

17.01 SIGNAL1 PARAM

Selects the first signal to be displayed on the control panel. The default signal is 1.03 FREQUENCY.
Value pointer: Group and index

17.02 SIGNAL2 PARAM

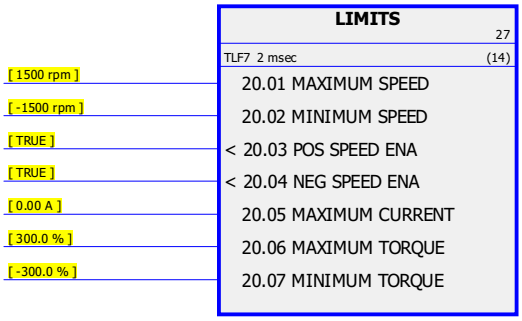
Selects the second signal to be displayed on the control panel. The default signal is 1.04 CURRENT.
Value pointer: Group and index

17.03 SIGNAL3 PARAM

Selects the third signal to be displayed on the control panel. The default signal is 1.06 TORQUE.
Value pointer: Group and index

LIMITS

(27)



Description

With the LIMITS block the user can adjust the drive speed, current and torque limits, select the source for the positive/negative speed reference enable command and enable the thermal current limitation.

Inputs

20.01 MAXIMUM SPEED

Defines the allowed maximum speed.
Range: 0…30000 rpm

20.02 MINIMUM SPEED

Defines the allowed minimum speed.
Range: -30000…0 rpm

20.03 POS SPEED ENA

Selects the source of the positive speed reference enable command.

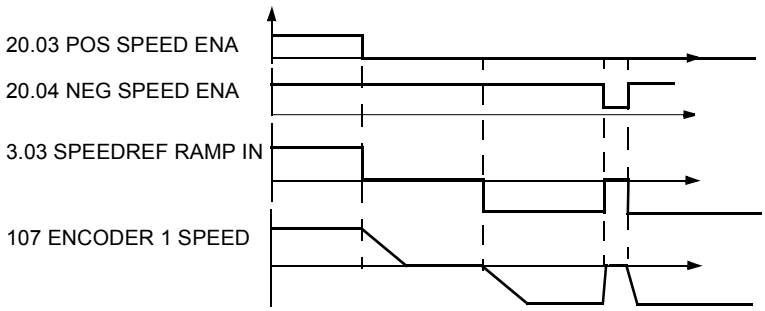
1 = Positive speed reference is enabled.
0 = Positive speed reference is interpreted as zero speed reference (In the figure below 3.03 SPEEDREF RAMP IN is set to zero after the positive speed enable signal has cleared). Actions in different control modes:

Speed control: Speed reference is set to zero and the motor is stopped along the currently active deceleration ramp.

Torque control: Torque limit is set to zero and the rush controller stops the motor.

Position and synchron control: Dynamic limiter sets the positioning speed reference to zero and the motor is stopped according to 70.06 POS DECEL LIM.

Homing and profile velocity mode control: Dynamic limiter sets the speed reference to zero and the motor is stopped according to 70.06 POS DECEL LIM.



Example: The motor is rotating in the forward direction. To stop the motor, the positive speed enable signal is deactivated by a hardware limit switch (e.g. via digital input). If the positive speed enable signal remains deactivated and the negative speed enable signal is active, only reverse rotation of the motor is allowed.

Bit pointer: Group, index and bit

20.04 NEG SPEED ENA

Selects the source of the negative speed reference enable command. See parameter 20.03 POS SPEED ENA.

Bit pointer: Group, index and bit

20.05 MAXIMUM CURRENT

Defines the allowed maximum motor current.

Range: 0…30000 A

20.06 MAXIMUM TORQUE

Defines the maximum torque limit for the drive (in percent of the motor nominal torque).

Range: 0…1600%

20.07 MINIMUM TORQUE

Defines the minimum torque limit for the drive (in percent of the motor nominal torque).

Range: -1600…0%

20.08 THERM CURR LIM

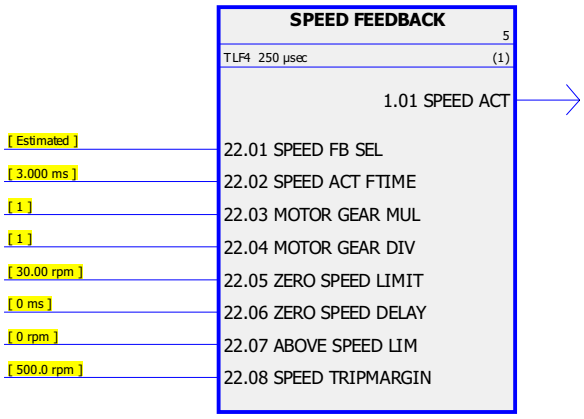
Enables the thermal current limitation. Thermal current limit is calculated by the inverter thermal protection function.

0 = ENABLE: The calculated thermal current value limits the inverter output current (i.e. motor current).

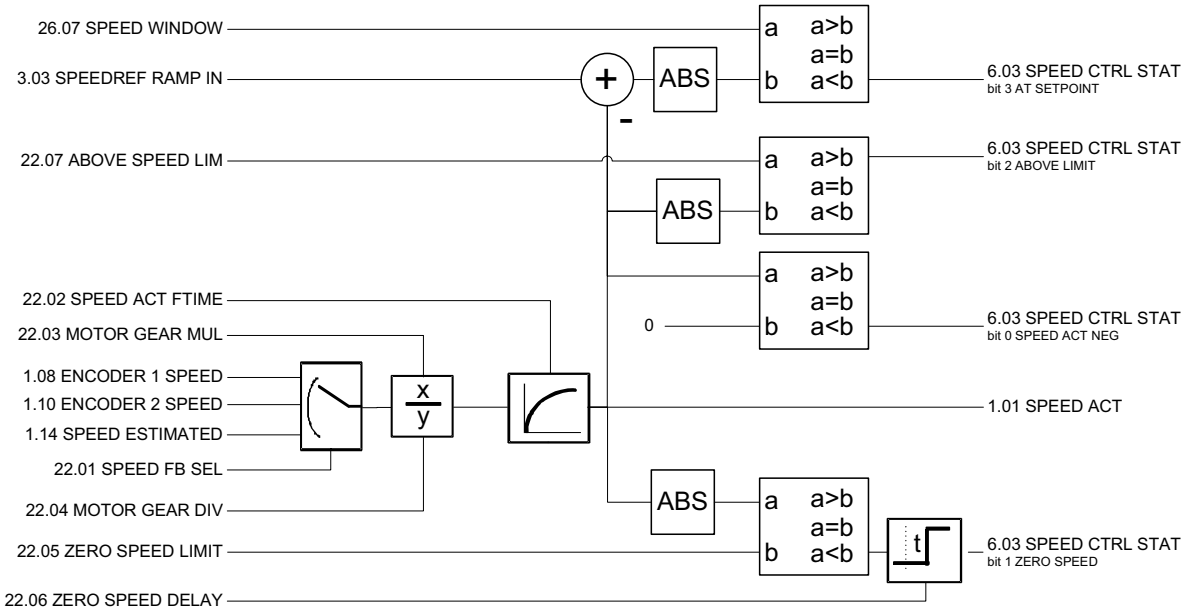
1 = DISABLE: The calculated thermal limit is not used. If the inverter output current is excessive, alarm IGBT OVERTEMP is generated and eventually the drive trips on fault IGBT OVERTEMP.

SPEED FEEDBACK

(5)



Block diagram



Description

With the SPEED FEEDBACK block the user can

- select the speed feedback used in drive control: a calculated value based on the motor model or a value measured with an encoder.
- filter the disturbances in the measured speed.
- define the motor encoder gear function.
- define the zero speed limit for the stop function.
- set the delay for the Zero Speed Delay function (used for smooth and quick restarting).
- define the limits for actual speed supervision.

The block also shows the filtered actual speed value.

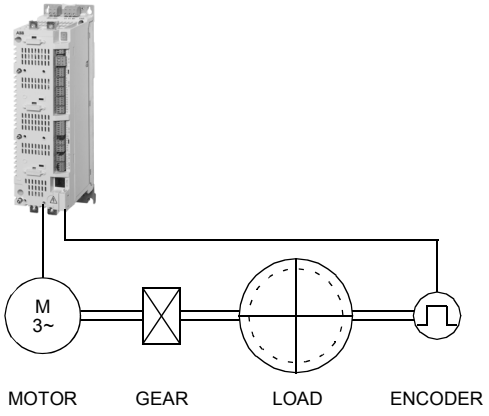
Motor encoder gear function

Note: If the motor gear ratio is not 1, the motor model uses the estimated speed instead of the speed feedback value.

The drive provides motor encoder gear function for compensating of mechanical gears between the motor shaft, the encoder and the load.

Motor encoder gear application example:

Speed control uses the motor speed. If no encoder is mounted on the motor shaft, the motor encoder gear function must be applied in order to calculate the actual motor speed on the basis of the measured load speed.



The motor encoder gear parameters 22.03 MOTOR GEAR MUL and 22.04 MOTOR GEAR DIV are set as follows:

$$\frac{\text{22.03 MOTOR GEAR MUL}}{\text{22.04 MOTOR GEAR DIV}} = \frac{\text{Actual speed}}{\text{Encoder 1/2 speed or Estimated speed}}$$

Inputs

22.01 SPEED FB SEL

Selects the speed feedback value used in control.

0 = ESTIMATED: Calculated speed estimate

1 = ENC1 SPEED: Actual speed measured with encoder 1. The encoder is selected by parameter 90.01 ENCODER 1 SEL.

2 = ENC2 SPEED: Actual speed measured with encoder 2. The encoder is selected by parameter 90.02 ENCODER 2 SEL.

22.02 SPEED ACT FTIME

Defines the time constant of the actual speed filter, i.e. time within the actual speed has reached 63% of the nominal speed (filtered speed = 1.01 SPEED ACT).

If the used speed reference remains constant, the possible interferences in the speed measurement can be filtered with the actual speed filter. Reducing the ripple with filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.

If there are substantial interferences in the speed measurement, the filter time constant should be proportional to the total inertia of the load and motor, in this case 10…30% of the mechanical time constant
$t_{mech} = (n_{nom} / T_{nom}) \times J_{tot} \times 2\pi / 60$, where
J_{tot} = total inertia of the load and motor (the gear ratio between the load and motor must be taken into account)
n_{nom} = motor nominal speed
T_{nom} = motor nominal torque

See also parameter 26.06 SPD ERR FTIME.

Range: 0…10000 ms

22.03 MOTOR GEAR MUL

Defines the motor gear numerator for the motor encoder gear function.

$$\frac{\text{22.03 MOTOR GEAR MUL}}{\text{22.04 MOTOR GEAR DIV}} = \frac{\text{Actual speed}}{\text{Input speed}}$$

where input speed is encoder 1/2 speed (1.08/1.10 ENCODER 1/2 SPEED) or speed estimate (1.14 SPEED ESTIMATED).

Range: -2^{31}… 2^{31} -1

Note: A setting of 0 is changed internally to 1.

22.04 MOTOR GEAR DIV

Defines the motor gear denominator for the motor encoder gear function. See parameter 22.03 MOTOR GEAR MUL.

Range: 1 … 2^{31} -1

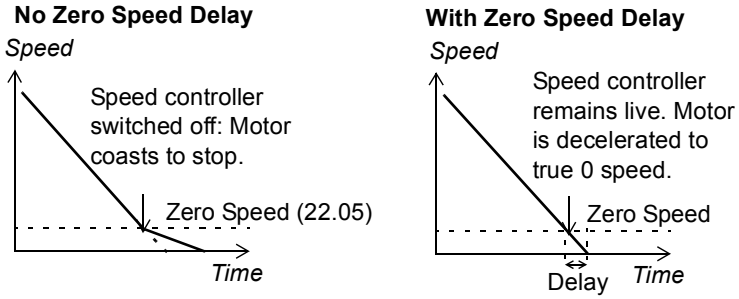
22.05 ZERO SPEED LIMIT

Defines the zero speed limit. The motor is stopped along a speed ramp until the defined zero speed limit is reached. After the limit, the motor coasts to stop.

Range: 0…30000 rpm

22.06 ZERO SPEED DELAY

Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay the drive knows accurately the rotor position.



No Zero Speed Delay

The drive receives a stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero Speed), the speed controller is switched off. The inverter modulation is stopped and the motor coasts to standstill.

With Zero Speed Delay

The drive receives a stop command and decelerates along a ramp. When the actual motor speed falls below an internal limit (called Zero Speed), the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetised and the drive is ready for a quick restart. Zero speed delay can be used e.g. with the jogging function.

Range: 0…30000 ms

22.07 ABOVE SPEED LIM

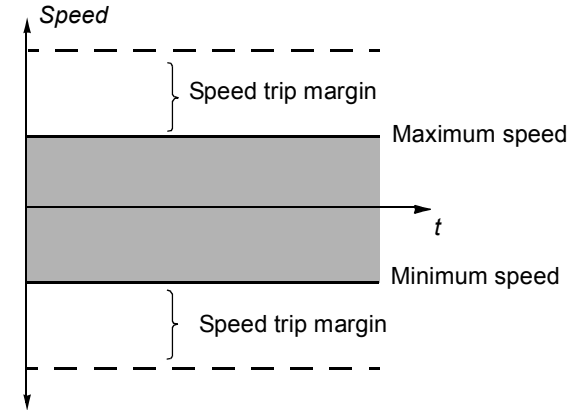
Defines the supervision limit for the actual speed.

Range: 0…30000 rpm

22.08 SPEED TRIPMARGIN

Defines together with 20.01 MAXIMUM SPEED and 20.02 MINIMUM SPEED the maximum allowed speed of the motor (overspeed protection). If the actual speed (1.01 SPEED ACT) exceeds the speed limit defined by parameter 20.01 or 20.02 by more than 22.08 SPEED TRIPMARGIN, the drive trips on fault OVERSPEED.

Example: If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm.



Range: 0…10000 rpm

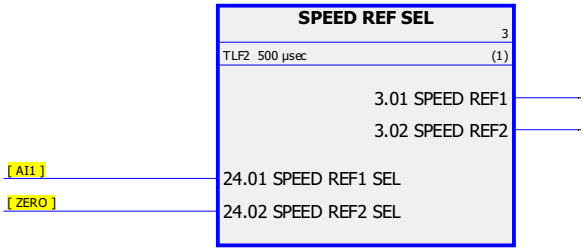
Outputs

1.01 SPEED ACT

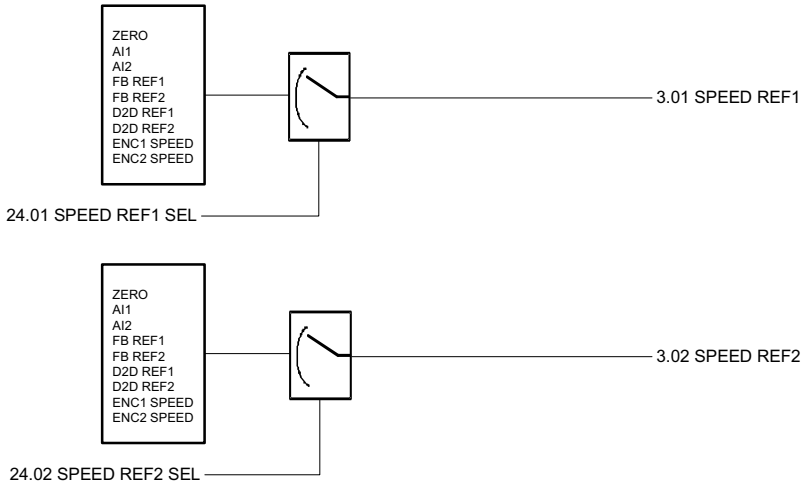
Filtered actual speed in rpm. Used speed feedback is defined by parameter 22.01 SPEED FB SEL. Filter time constant can be adjusted by parameter 22.02 SPEED ACT FTIME.

SPEED REF SEL

(3)



Block diagram



Description

With the SPEED REF SEL block the user can select the sources for two speed references, REF1 or REF2, from a parameter selection list. The block also shows speed reference 1/2 value.

The user can also select the speed reference source with a value pointer parameter. See firmware block SPEED REF MOD on page *93*.

Depending on the user selection, either speed reference or speed reference 2 is active at a time.

Inputs

24.01 SPEED REF1 SEL

Selects the source for speed reference 1 (3.01 SPEED REF1).

0 = ZERO: Zero reference

1 = AI1: Analogue input AI1

2 = AI2: Analogue input AI2

3 = FBA REF1: Fieldbus reference 1

4 = FBA REF2: Fieldbus reference 2

5 = D2D REF1: Drive to drive reference 1.

6 = D2D REF2: Drive to drive reference 2.

7 = ENC1 SPEED: Encoder 1 (1.08 ENCODER 1 SPEED)

8 = ENC2 SPEED: Encoder 2 (1.10 ENCODER 2 SPEED)

Source for the speed reference 1/2 can also be selected by a value pointer parameter 24.03 SPEED REF1 IN / 24.04 SPEED REF2 IN.

24.02 SPEED REF2 SEL

Selects the source for speed reference 2 (3.02 SPEED REF2).

See parameter 24.01 SPEED REF1 SEL.

Outputs

3.01 SPEED REF1

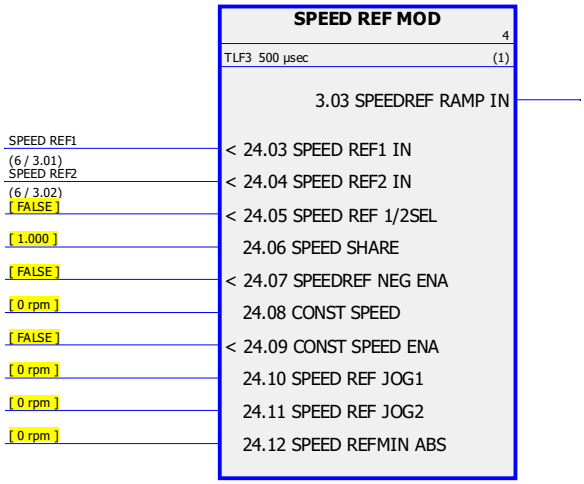
Speed reference 1 in rpm

3.02 SPEED REF2

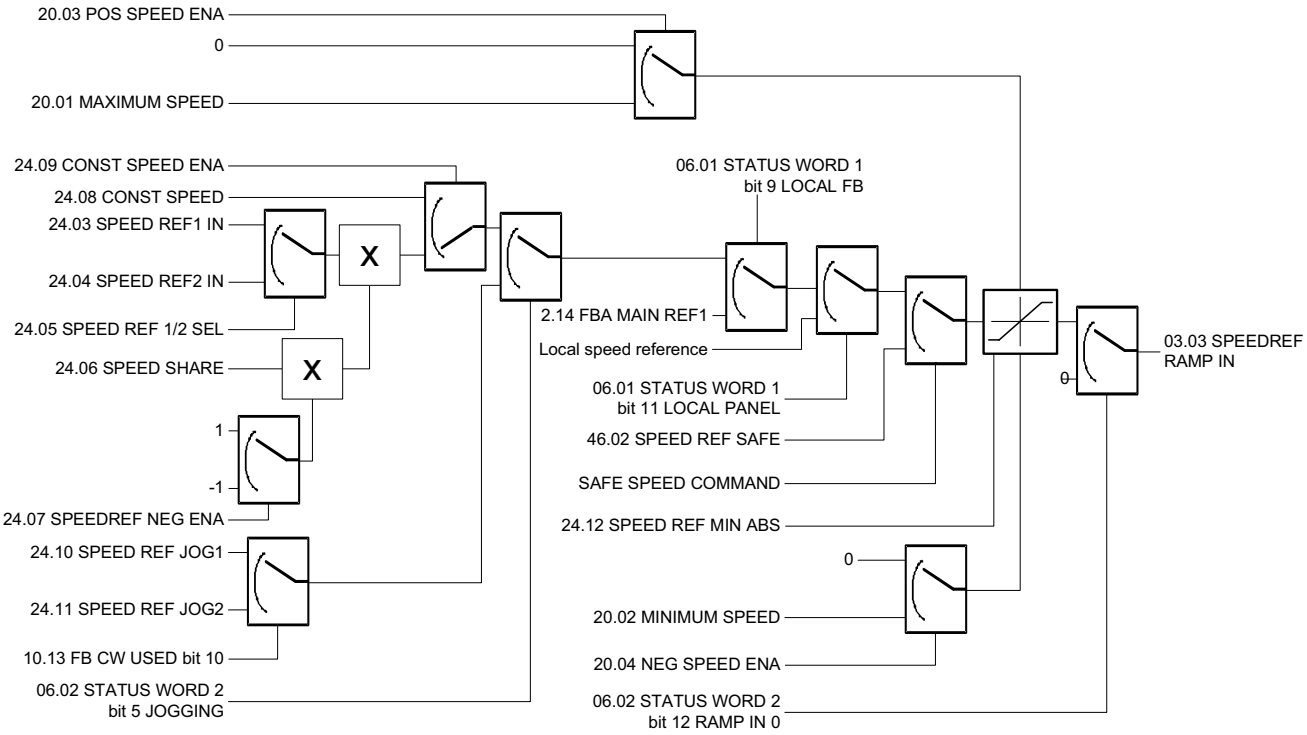
Speed reference 2 in rpm

SPEED REF MOD

(4)



Block diagram



Description

With the SPEED REF MOD block the user can

- select the sources for two speed references, REF1 or REF2.
- scale and invert the speed reference.
- define the constant speed reference.
- define jogging function 1/2 speed reference.
- define the speed reference absolute minimum limit.

The source for the speed reference REF1 or REF2 can also be selected from a parameter selection list. See firmware block SPEED REF SEL on page *91*.

Depending on the user selection, either speed reference 1 or speed reference 2 is active at a time.

Speed reference can be any of the following (in priority order)

- fault speed reference (in a control panel or PC tool communication break)
- local speed reference (from panel)
- fieldbus local reference
- jogging reference 1/2
- constant speed reference 1/2
- external speed reference.

Note: Constant speed overrides external speed reference.

Speed reference is limited according to the set minimum and maximum speed values and ramped and shaped according to the defined acceleration and deceleration values. See firmware block *SPEED REF RAMP* on page *97*.

Inputs

24.03 SPEED REF1 IN

Selects the source for speed reference 1 (overrides parameter 24.01 SPEED REF1 SEL setting). The default value is P.3.1, i.e. 3.01 SPEED REF1, which is the output of the *SPEED REF RAMP* block.

Value pointer: Group and index

24.04 SPEED REF2 IN

Selects the source for speed reference 2 (overrides parameter 24.02 SPEED REF2 SEL setting). The default value is P.3.2, i.e. 3.02 SPEED REF2, which is the output of the *SPEED REF RAMP* block.

Value pointer: Group and index

24.05 SPEED REF 1/2SEL

Selects between speed reference 1 or 2. Reference 1/2 source is defined by parameter 24.03 SPEED REF1 IN / 24.04 SPEED REF2 IN. 0 = Speed reference 1.

Bit pointer: Group, index and bit

24.06 SPEED SHARE

Defines the scaling factor for speed reference 1/2 (speed reference 1 or 2 is multiplied by the defined value). Speed reference 1 or 2 is selected by parameter 24.05 SPEED REF 1/2SEL.

Range: -8…8

24.07 SPEEDREF NEG ENA

Selects the source for the speed reference inversion. 1 = Sign of the speed reference is changed (inversion active).

Bit pointer: Group, index and bit

24.08 CONST SPEED

Defines the constant speed.

Range: -30000…30000 rpm

24.09 CONST SPEED ENA

Selects the source for enabling the use of the constant speed reference define by parameter 24.08 CONST SPEED. 1 = Enable.

Bit pointer: Group, index and bit

24.10 SPEED REF JOG1

Defines the speed reference for jogging function 1. For more information on jogging, see section *Jogging* on page *64*.

Range: -30000…30000 rpm

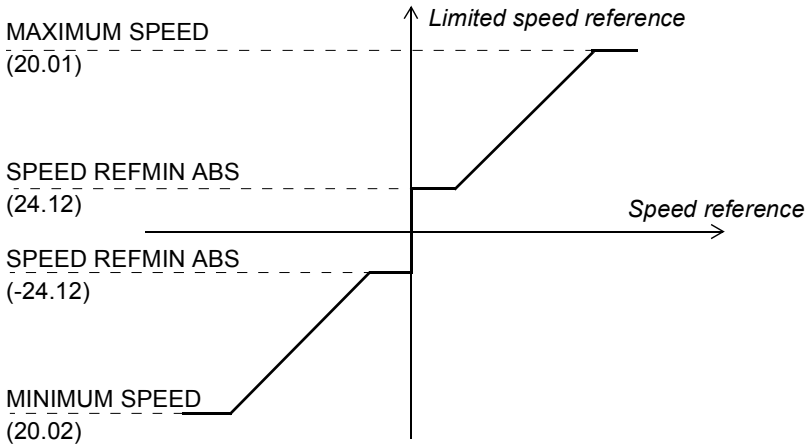
24.11 SPEED REF JOG2

Defines the speed reference for jogging function 2. For more information on jogging, see section *Jogging* on page *64*.

Range: -30000…30000 rpm

24.12 SPEED REFMIN ABS

Defines the absolute minimum limit for the speed reference.



Range: 0…30000 rpm

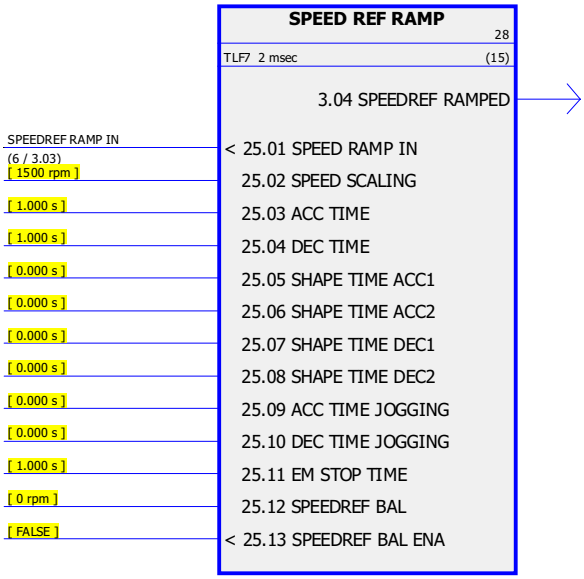
Outputs

3.03 SPEEDREF RAMP IN

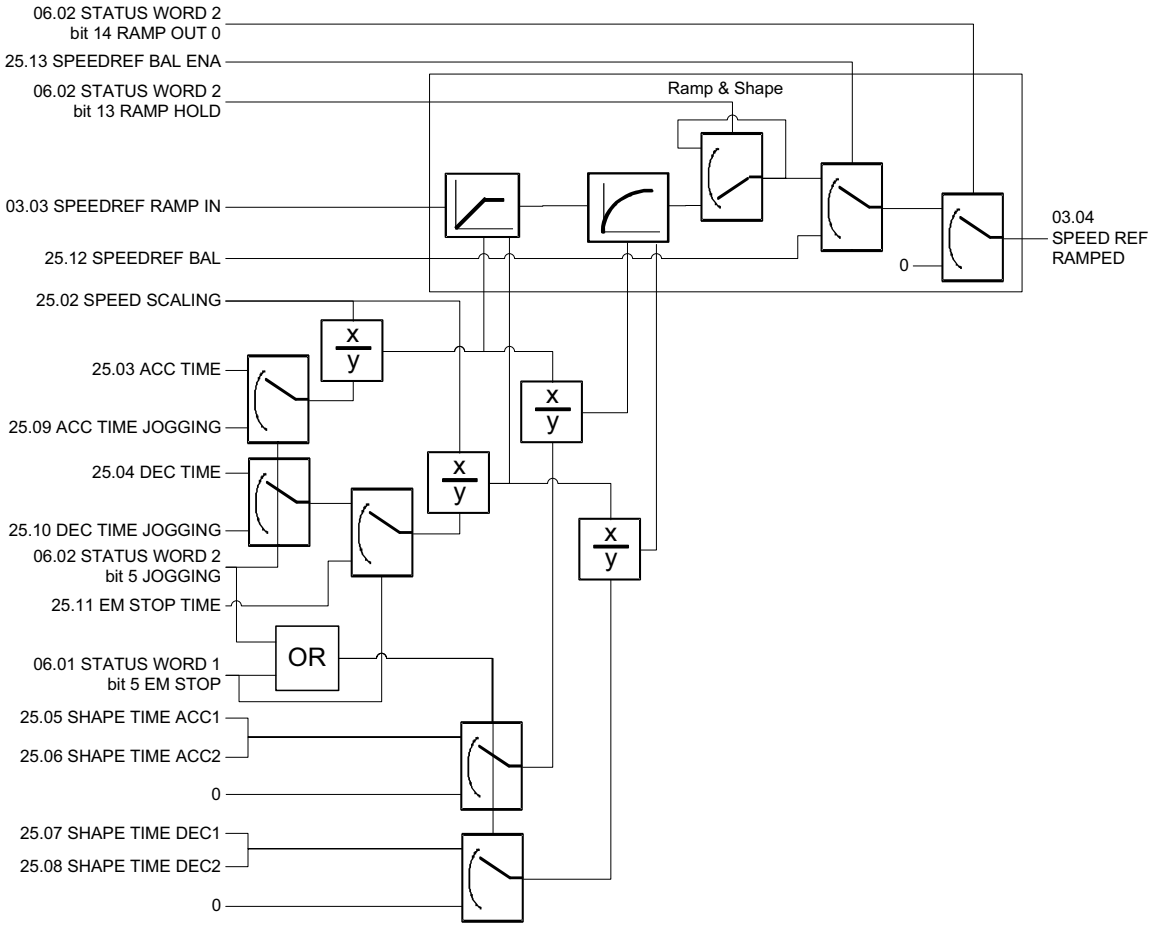
Used speed reference ramp input in rpm

SPEED REF RAMP

(28)



Block diagram



Description

With the SPEEDREF RAMP block the user can

- select the source for the speed ramp input.
- adjust the acceleration and deceleration times (also for the jogging function).
- adjust the acceleration and deceleration ramp shapes.
- adjust the emergency stop OFF3 ramp time.
- force the output of the speed reference ramp block to a defined value with the speed reference ramp balancing function.

The block also shows the ramped and shaped speed reference value.

Note: Emergency stop OFF1 uses the active ramp time.

Acceleration and deceleration ramps

Speed reference is ramped and shaped according the to the defined acceleration and deceleration values. The available ramp shape alternatives are Linear and S-curve.

Linear: Suitable for drives requiring steady or slow acceleration/deceleration.

S-curve: Ideal for lifting applications.

Note: When jogging or emergency ramp stop is active, acceleration and deceleration shape times are forced to zero.

Inputs

25.01 SPEED RAMP IN

Shows the source of the speed ramp input. The default value is P.3.3 i.e. signal 3.03 SPEEDREF RAMP IN, which is the output of the *SPEED REF MOD* firmware block.

Note: This parameter cannot be set by the user.

Value pointer: Group and index

25.02 SPEED SCALING

Defines the speed value used in acceleration and deceleration (parameters 25.03/25.09 and 25.04/25.10/25.11).

Range: 0…30000 rpm

25.03 ACC TIME

Defines the acceleration time i.e. the time required for the speed to change from zero to the speed value defined by parameter 25.02 SPEED SCALING.

- If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate.

- If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference signal.

- If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.

Range 0…1800 s

25.04 DEC TIME

Defines the deceleration time i.e. the time required for the speed to change from the speed value defined by parameter 25.02 SPEED SCALING to zero.

- If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference signal.

- If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate.

- If the deceleration time is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits. If there is any doubt about the deceleration time being too short, ensure that the DC overvoltage control is on (parameter 47.01 OVERVOLTAGE CTRL).

Note: If a short deceleration time is needed for a high inertia application, the drive should be equipped with an electric braking option e.g. with a brake chopper (built-in) and a brake resistor.

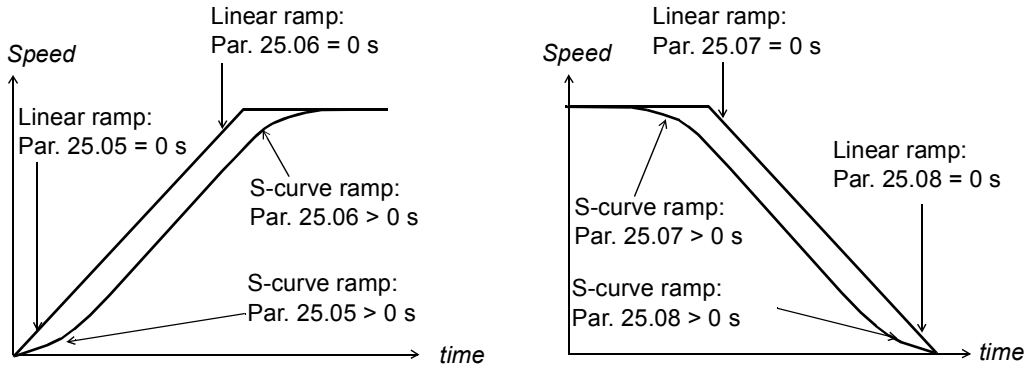
Range: 0…1800 s

25.05 SHAPE TIME ACC1

Selects the shape of the acceleration ramp at the beginning of the acceleration.

0.00 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps.

0.01…1000.00 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between.



Range: 0…1000 s

25.06 SHAPE TIME ACC2

Selects the shape of the acceleration ramp at the end of the acceleration. See parameter 25.05 SHAPE TIME ACC1.

Range: 0…1000 s

25.07 SHAPE TIME DEC1

Selects the shape of the deceleration ramp at the beginning of the deceleration. See parameter 25.05 SHAPE TIME ACC1.

Range: 0…1000 s

25.08 SHAPE TIME DEC2

Selects the shape of the deceleration ramp at the end of the deceleration.

Range: 0…1000 s

See parameter 25.05 SHAPE TIME ACC1.

25.09 ACC TIME JOGGING

Defines the acceleration time for the jogging function i.e. the time required for the speed to change from zero to the speed value defined by parameter 25.02 SPEED SCALING.

Range: 0…1800 s

25.10 DEC TIME JOGGING

Defines the deceleration time for the jogging function i.e. the time required for the speed to change from the speed value defined by parameter 25.02 SPEED SCALING to zero.

Range: 0…1800 s

25.11 EM STOP TIME

Defines the time inside which the drive is stopped if an emergency stop OFF3 is activated (i.e. the time required for the speed to change from the speed value defined by parameter 25.02 SPEED SCALING to zero). Emergency stop activation source is selected by parameter 10.10 EM STOP OFF3. Emergency stop can also be activated through fieldbus (2.12 FBA MAIN CW).

Emergency stop OFF1 uses the active ramp time.

Range: 0…1800 s

25.12 SPEEDREF BAL

Defines the reference for the speed ramp balancing, i.e. the output of the speed reference ramp firmware block is forced to a defined value.

The source for the balancing enable signal is selected by parameter 25.13 SPEEDREF BAL.

Range: -30000…30000 rpm

25.13 SPEEDREF BAL ENA

Selects the source for enabling the speed ramp balancing. See parameter 25.12 SPEEDREF BAL. 1 = Speed ramp balancing enabled.

Bit pointer: Group, index and bit

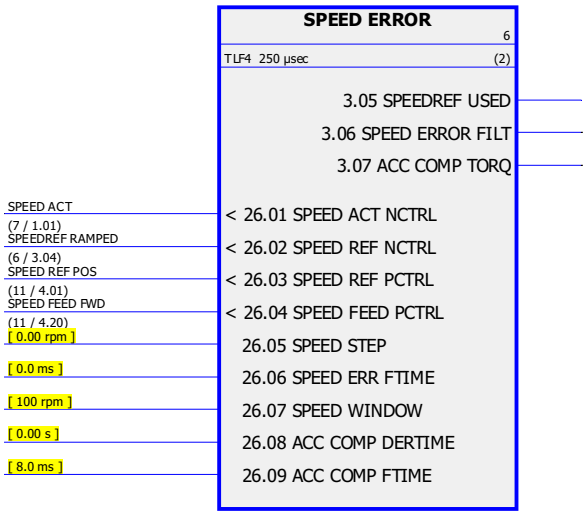
Outputs

3.04 SPEEDREF RAMPED

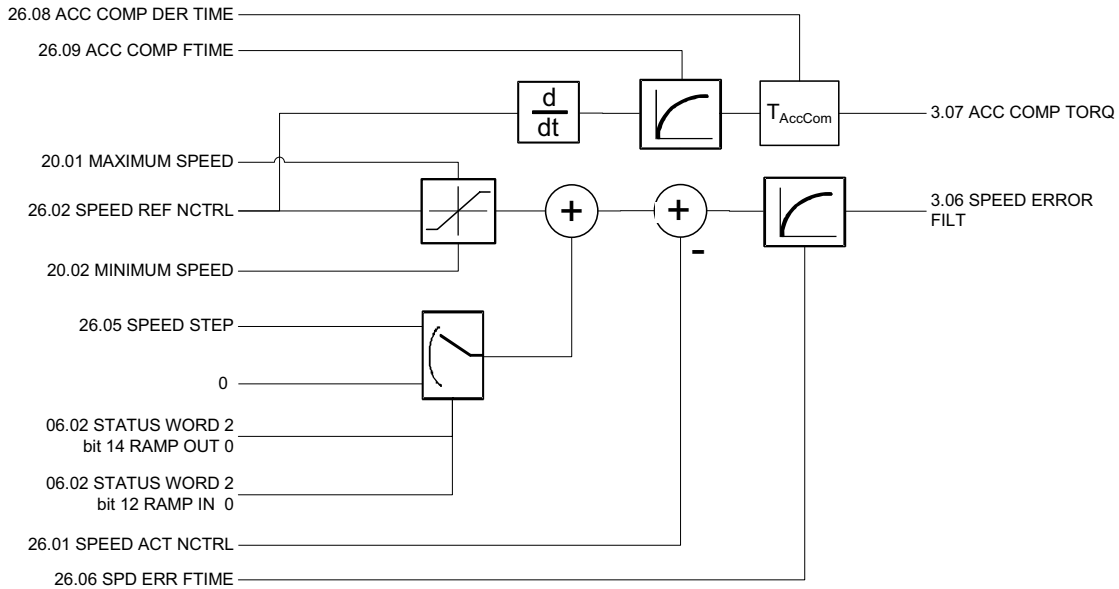
Ramped and shaped speed reference in rpm

SPEED ERROR

(6)



Block diagram



Description

With the SPEED ERROR block the user can

- select the source for the speed error calculation (speed reference - actual speed) in different control modes.
- select the sources for the speed reference and speed reference feedforward (only for positioning applications).
- filter the speed error.
- add an additional speed step to the speed error.
- supervise the speed error with the speed window function.

- compensate inertia during acceleration (with the acceleration compensation).

The block also shows the used speed reference, filtered speed error and the output of the acceleration compensation.

Inputs

26.01 SPEED ACT NCTRL

Selects the source for the actual speed in the speed control mode.

Note: This parameter has been locked, i.e. no user setting is possible.

Value pointer: Group and index

26.02 SPEED REF NCTRL

Selects the source for the speed reference in the speed control mode.

Note: This parameter has been locked, i.e. no user setting is possible.

Value pointer: Group and index

26.03 SPEED REF PCTRL

Selects the source for the speed reference in position and synchron control modes.

Note: This parameter is only for positioning applications.

Value pointer: Group and index

26.04 SPEED FEED PCTRL

Selects the source for the speed reference feedforward in position and synchron control modes. Selects the source for the speed reference in homing and profile velocity modes.

Note: This parameter is only for positioning applications.

Value pointer: Group and index

26.05 SPEED STEP

Defines an additional speed step given to the input of the speed controller (added to the speed error value).

Range: -30000…30000 rpm

26.06 SPD ERR FTIME

Defines the time constant of the speed error low pass filter.

If the used speed reference changes rapidly (servo application), the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.

See also parameter 22.02 SPEED ACT FTIME.

Range: 0…1000 ms. If parameter value is set to zero, the filter is disabled.

26.07 SPEED WINDOW

Defines the absolute value for the motor speed window supervision, i.e. the absolute value for the difference between the actual speed and the unramped speed reference (1.01 SPEED ACT - 3.03 SPEEDREF RAMP IN). When the motor speed is within the limits defined by this parameter, signal 2.13 bit 8 (AT_SETPOINT) value is 1. If the motor speed is not within the defined limits, bit 8 value is 0.

Range: 0…30000 rpm

26.08 ACC COMP DERTIME

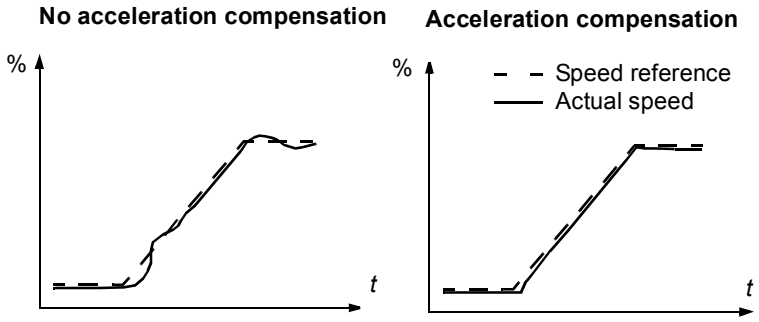
Defines the derivation time for acceleration (deceleration) compensation. Used to improve the speed control dynamic reference change.

In order to compensate inertia during acceleration, a derivative of the speed reference is added to the output of the speed controller. The principle of a derivative action is described for parameter 28.04 DERIVATION TIME.

Note: The parameter value should be proportional to the total inertia of the load and motor, i.e. approximately 10…30% of the mechanical time constant (t_{mech}). See the mechanical time constant equation in parameter 22.02 SPEED ACT FTIME.

If parameter value is set to zero, the function is deactivated.

The figure below shows the speed responses when a high inertia load is accelerated along a ramp.



See also parameter 26.09 ACC COMP FTIME.

The source for the acceleration compensation torque can also be selected by parameter 28.06 ACC COMPENSATION. See firmware block SPEED CONTROL on page *104*.

Range: 0…600 s

26.09 ACC COMP FTIME

Defines the filter time for the acceleration compensation.

Range: 0…1000 ms. If parameter value is set to zero, the filter is disabled.

Outputs

3.05 SPEEDREF USED

Used speed reference in rpm (reference before the speed error calculation)

3.06 SPEED ERROR FILT

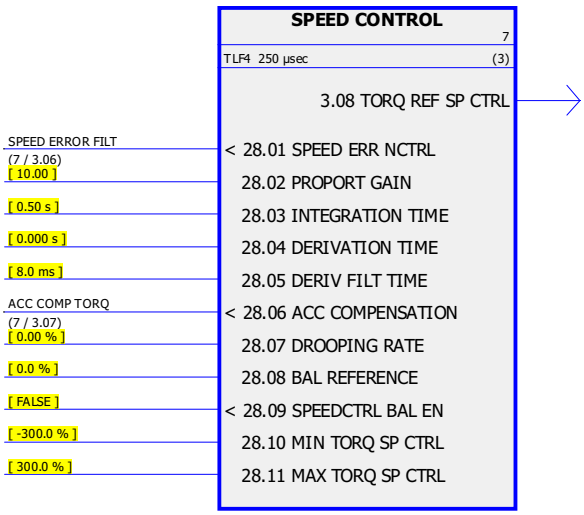
Filtered speed error value in rpm

3.07 ACC COMP TORQ

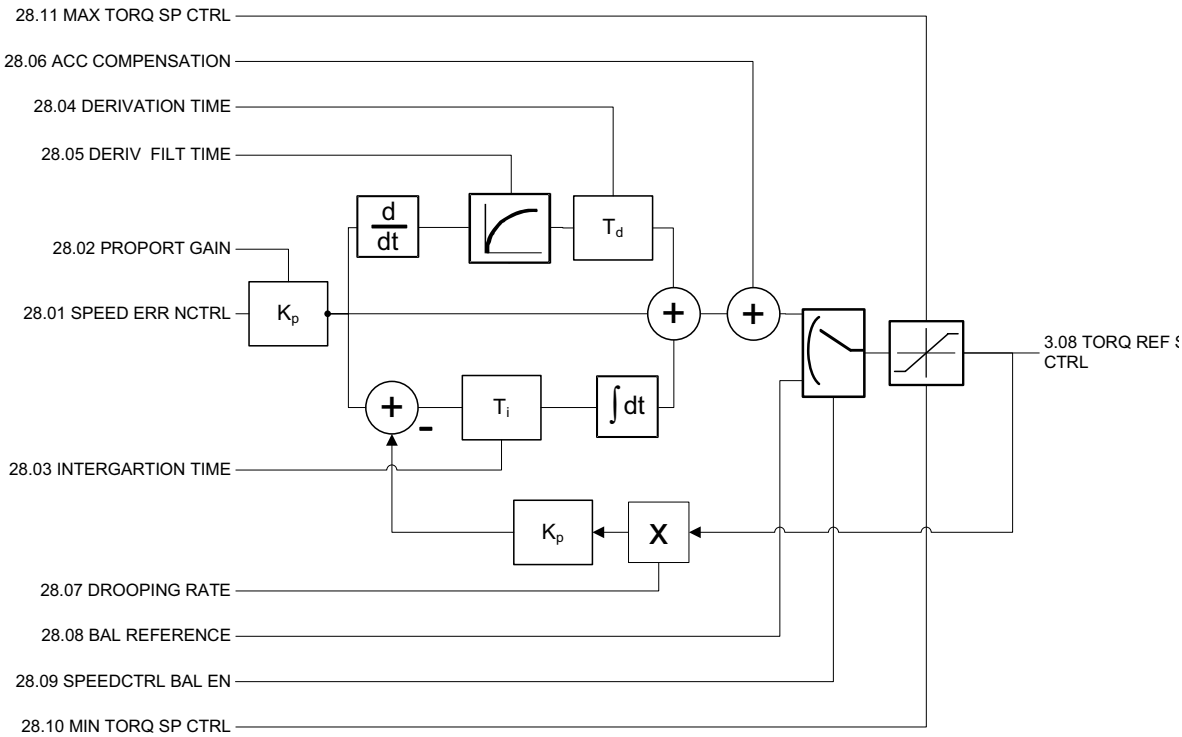
Output of the acceleration compensation (torque in %)

SPEED CONTROL

(7)



Block diagram



Description

With the SPEED CONTROL block the user can

- select the source for the speed error.
- adjust the PID-type speed controller variables.
- limit the speed controller output torque.
- select the source for the acceleration compensation torque.
- force an external value to the output of the speed controller (with the balancing function).
- adjust the load sharing in a Master/Follower application run by several drives (with the drooping function).

The block also shows the limited speed controller output torque value.

The speed controller includes an anti-windup function (i.e. controller I-term is frozen during torque reference limitation).

In torque control mode the speed controller output is frozen.

For manual speed controller tuning, see section Manual speed controller tuning on page *26*.

Inputs

28.01 SPEED ERR NCTRL

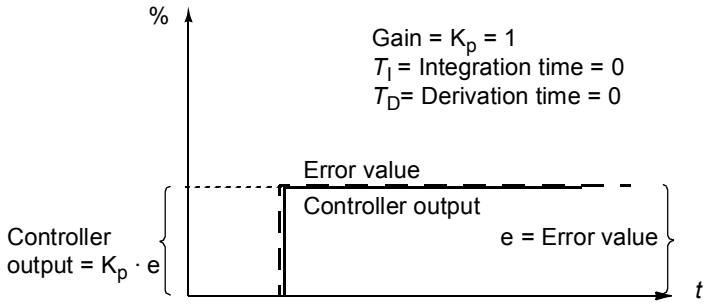
Selects the source for the speed error (reference - actual). The default value is P.3.6 i.e. signal 3.06 SPEED ERROR FILT, which is the output of the SPEED ERROR firmware block.

Note: This parameter has been locked, i.e. no user setting is possible.

Value pointer: Group and index

28.02 PROPORT GAIN

Defines the proportional gain (K_p) of the speed controller. Too great gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.



If gain is set to 1, a 10% change in error value (reference - actual value) causes the speed controller output to change by 10%.

Range: 0…200

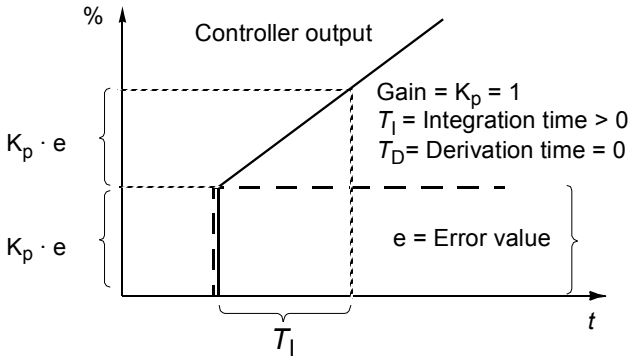
28.03 INTEGRATION TIME

Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. Too short integration time makes the control unstable.

If parameter value is set to zero, the I-part of the controller is disabled.

Anti-windup stops the integrator if the controller output is limited. See 6.05 LIMIT WORD 1.

The figure below shows the speed controller output after an error step when the error remains constant.



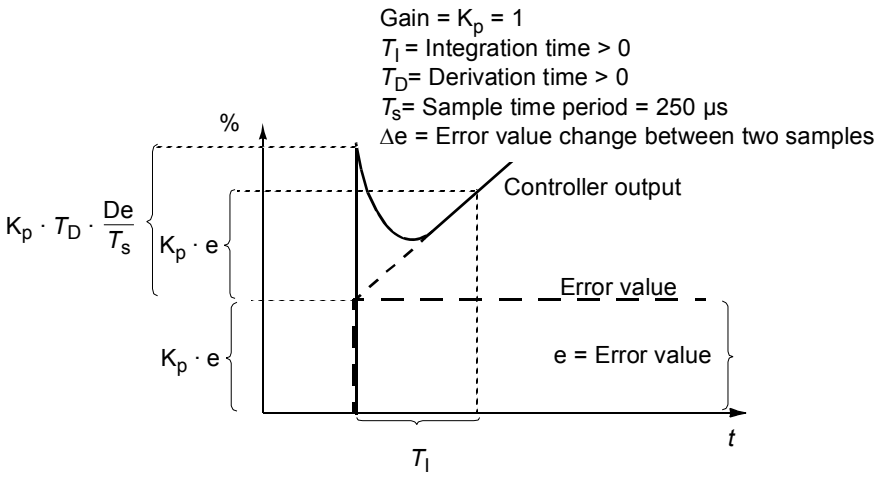
Range: 0…600 s

28.04 DERIVATION TIME

Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances.

The speed error derivative must be filtered with a low pass filter to eliminate disturbances.

The figure below shows the speed controller output after an error step when the error remains constant.



Note: Changing this parameter value is recommended only if a pulse encoder is used.

Range: 0…10 s

28.05 DERIV FILT TIME

Defines the derivation filter time constant.

Range: 0…1000 ms

28.06 ACC COMPENSATION

Selects the source for the acceleration compensation torque.

The default value is P.3.7, i.e signal 3.07 ACC COMP TORQ, which is the output of the SPEED ERROR firmware block.

Note: This parameter has been locked, i.e. no user setting is possible.

Value pointer: Group and index

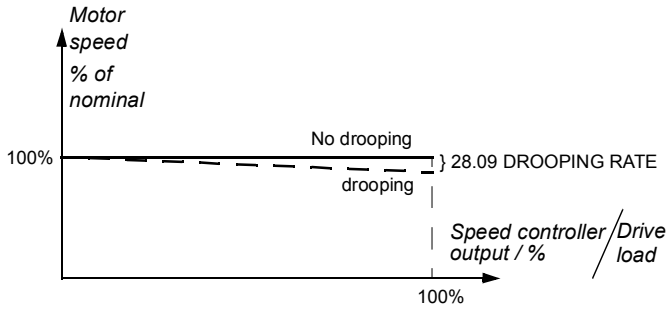
28.07 DROOPING RATE

Defines the droop rate (in percent of the motor nominal speed). The drooping slightly decreases the drive speed as the drive load increases. The actual speed decrease at a certain operating point depends on the droop rate setting and the drive load (= torque reference / speed controller output). At 100% speed controller output, drooping is at its nominal level, i.e. equal to the value of the DROOPING RATE. The drooping effect decreases linearly to zero along with the decreasing load.

Drooping rate can be used e.g. to adjust the load sharing in a Master/Follower application run by several drives. In a Master/Follower application the motor shafts are coupled to each other.

The correct droop rate for a process must be found out case by case in practice.

Speed decrease = Speed controller output · Drooping · Max. speed
Example: Speed controller output is 50%, drooping rate is 1%, maximum speed of the drive is 1500 rpm. Speed decrease = 0.50 · 0.01 · 1500 rpm = 7.5 rpm.



Range: 0…100%

28.08 BAL REFERENCE

Defines the reference used in the speed control output balancing, i.e. an external value to be forced to the output of the speed controller. In order to guarantee smooth operation during output balancing, the speed controller D-part is disabled and the acceleration compensation term is set to zero.

The source for the balancing enable signal is selected by parameter 28.09 SPEEDCTRL BAL EN.

Range: -1600…1600%

28.09 SPEEDCTRL BAL EN

Selects the source for the speed control output balancing enable signal. See parameter 28.08 BAL REFERENCE. 1 = Enabled. 0 = Disabled.

Bit pointer: Group, index and bit

28.10 MIN TORQ SP CTRL

Defines the minimum speed controller output torque.
Range: -1600…1600%

28.11 MAX TORQ SP CTRL

Defines the maximum speed controller output torque.
Range: -1600…1600%

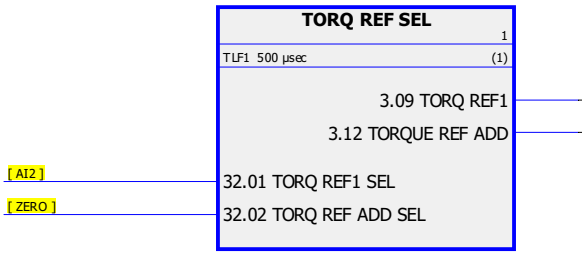
Outputs

3.08 TORQ REF SP CTRL

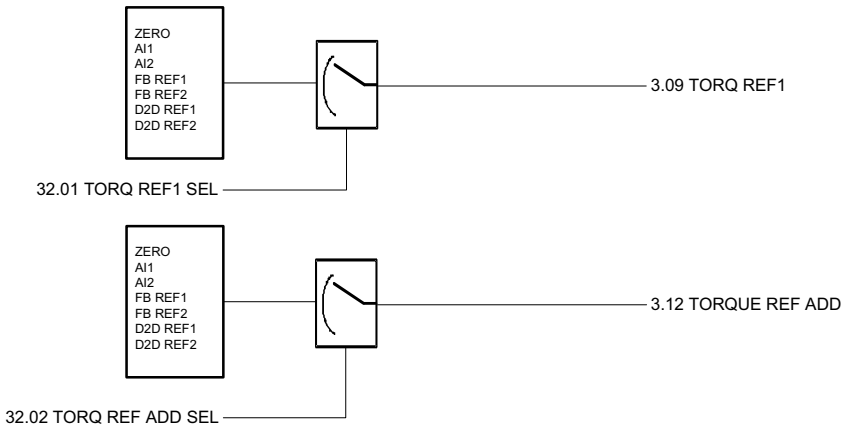
Limited speed controller output torque in %

TORQ REF SEL

(1)



Block diagram



Description

With the TORQ REF SEL block the user can select the source for torque reference 1 (from a parameter selection list) and the source for torque reference addition (used e.g. for compensating mechanical interferences).

This block also shows the torque reference and reference addition values.

The user can also select the torque reference source with a value pointer parameter. See firmware block TORQ REF MOD on page *111*.

Inputs

32.01 TORQ REF1 SEL

Selects the source for torque reference 1.

0 = ZERO: Zero reference

1 = AI1: Analogue input AI1

2 = AI2: Analogue input AI2

3 = FBA REF1: Fieldbus reference 1

4 = FBA REF2: Fieldbus reference 2

5 = D2D REF1: Drive to drive reference 1.

6 = D2D REF2: Drive to drive reference 2.

32.02 TORQ REF ADD SEL

Selects the source for the torque reference addition, 3.12 TORQUE REF ADD. Parameter 34.10 TORQ REF ADD SRC is connected to signal 3.12 TORQUE REF ADD as default.

Because the reference is added after the torque reference selection, this parameter can be used in speed and torque control modes. See block diagram in firmware block *REFERENCE CTRL* on page *113*.

0 = ZERO: Zero reference

1 = AI1: Analogue input AI1

2 = AI2: Analogue input AI2

3 = FBA REF1: Fieldbus reference 1

4 = FBA REF2: Fieldbus reference 2

5 = D2D REF1: Drive to drive reference 1.

6 = D2D REF2: Drive to drive reference 2.

Outputs

3.09 TORQ REF1

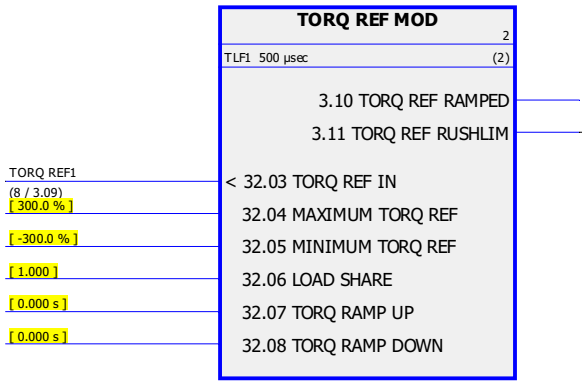
Torque reference 1 in %

3.12 TORQUE REF ADD

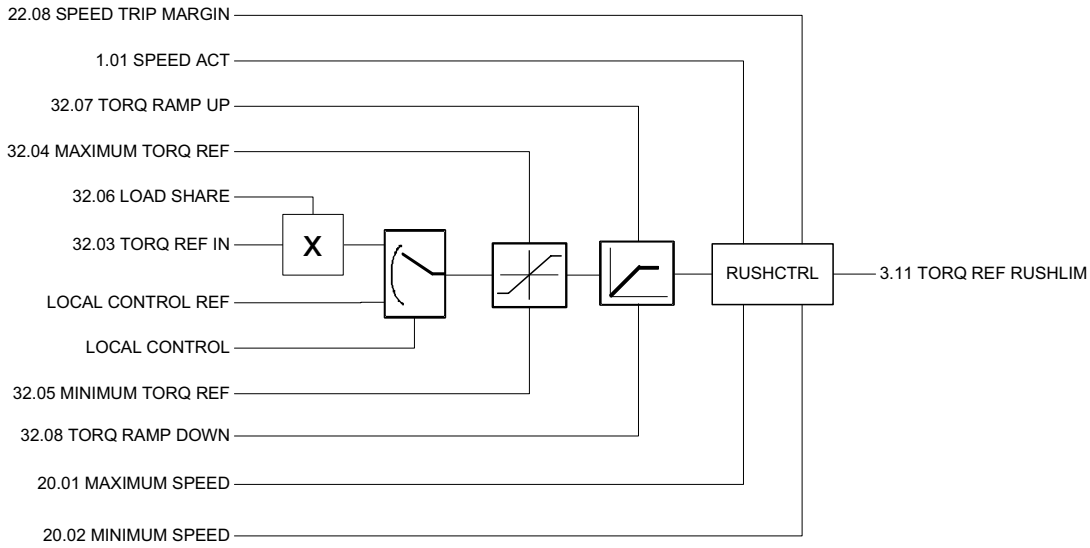
Torque reference additive in %.

TORQ REF MOD

(2)



Block diagram



Description

With the TORQ REF MOD block the user can

- select the source for the torque reference.
- scale the input torque reference according to the defined load share factor.
- limit the torque reference according to the defined minimum and maximum limits.
- ramp the torque reference according to the defined ramp times.

The block also shows the ramped torque reference value and the torque reference value limited by the rush control.

If local torque reference is used, no load share scaling is applied.

In torque control, the drive speed is limited between the defined minimum and maximum limits. Speed-related torque limits are calculated and the input torque reference is limited according to these limits. An OVERSPEED fault is generated if the maximum allowed speed is exceeded.

Inputs

32.03 TORQ REF IN

Selects the source for the torque reference input for the torque ramp function. The default value is P.3.9, i.e. signal 3.09 TORQ REF1, which is the output of the TORQ REF SEL firmware block.

Value pointer: Group and index

32.04 MAXIMUM TORQ REF

Defines the maximum torque reference.

Range: 0…1000%

32.05 MINIMUM TORQ REF

Defines the minimum torque reference.

Range: -1000…0%

32.06 LOAD SHARE

Scales the external torque reference to a required level (external torque reference is multiplied by the selected value).

Range: -8…8

32.07 TORQ RAMP UP

Defines the torque reference ramp up time, i.e. the time for the reference to increase from zero to the nominal motor torque.

Range: 0…60 s

32.08 TORQ RAMP DOWN

Defines the torque reference ramp down time, i.e. the time for the reference to decrease from the nominal motor torque to zero.

Range: 0…60 s

Outputs

3.10 TORQ REF RAMPED

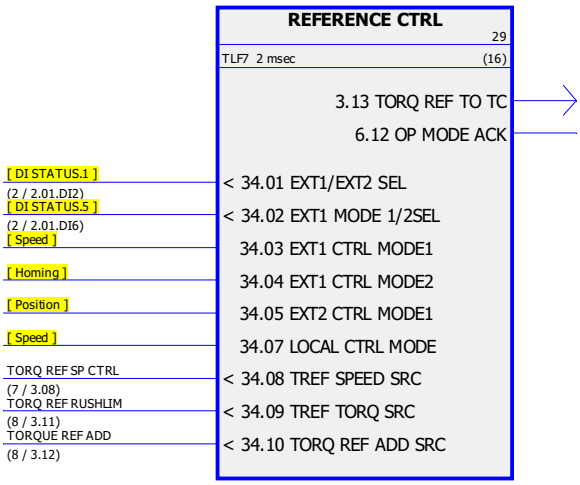
Ramped torque reference in %

3.11 TORQ REF RUSHLIM

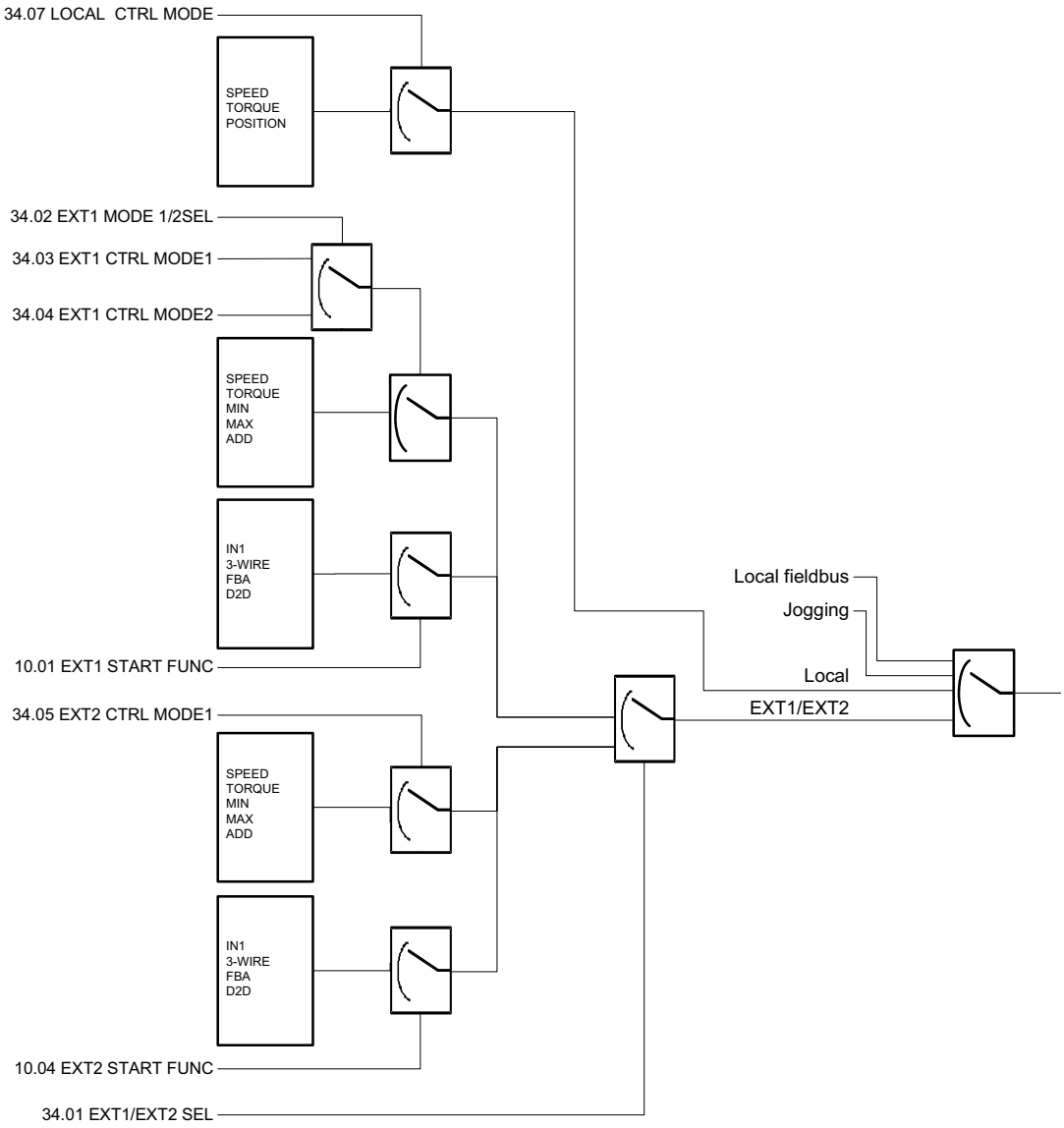
Torque reference limited by the rush control (value in %). Torque is limited to ensure that the speed is between the defined minimum and maximum speed limits (parameters 20.01 MAXIMUM SPEED and 20.02 MINIMUM SPEED).

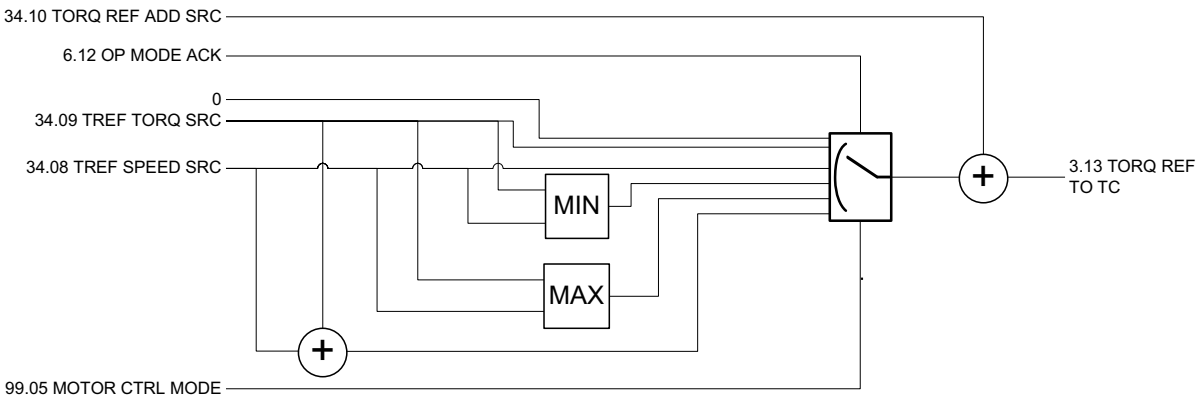
REFERENCE CTRL

(29)



Block diagram





Description

With the REFERENCE CTRL block the user can

- select whether external control location EXT1 or EXT2 is used. Either one is active at a time.
- select the control mode (SPEED/TORQUE/MIN/MAX/ADD) and the used torque reference in local and external control.

The block also shows the torque reference (for torque control) and the used control mode.

For more information on control locations and control modes, see chapter *Control locations and operating modes*.

For start/stop control in different control locations, see firmware block DRIVE LOGIC on page *64*.

Inputs

34.01 EXT1/EXT2 SEL

Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1. 1 = EXT2.
Bit pointer: Group, index and bit

34.02 EXT1 MODE 1/2SEL

Selects the source for EXT1 control mode 1/2 selection. 1 = mode 2. 0 = mode 1.
Control mode 1/2 is selected by parameter 34.03/34.04 EXT1 CTRL MODE1/2.
Bit pointer: Group, index and bit

34.03 EXT1 CTRL MODE1

Selects the control mode 1 for external control location EXT1.

1 = SPEED: Speed control. Torque reference is 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block. Torque reference source can be changed by parameter 34.08 TREF SPEED SRC.

2 = TORQUE: Torque control. Torque reference is 3.11 TORQ REF RUSHLIM, which is the output of the TORQ REF MOD firmware block. Torque reference source can be changed by parameter 34.08 TREF SPEED SRC.

3 = MIN: Combination of selections SPEED and TORQUE: Torque selector compares the torque reference and the speed controller output and the smaller of them is used.

4 = MAX: Combination of selections SPEED and TORQUE: Torque selector compares the torque reference and the speed controller output and the greater of them is used.

5 = ADD: Combination of selections SPEED and TORQUE: Torque selector adds the speed controller output to the torque reference.

Note: Selections 6 to 9 are only for positioning applications.

6 = POSITION: Position control. Torque reference is 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block. Speed reference is 4.01 SPEED REF POS, which is the output of the POS CONTROL firmware block. Speed reference source can be changed by parameter 26.03 SPEED REF PCTRL.

7 = SYNCHRON: Synchron control. Torque reference is 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block. Speed reference is 4.01 SPEED REF POS, which is the output of the POS CONTROL firmware block. Speed reference source can be changed by parameter 26.03 SPEED REF PCTRL.

8 = HOMING: Homing control. Torque reference is 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block. Speed reference is 4.20 SPEED FEED FWD, which is the output of the POS CONTROL firmware block. Speed reference source can be changed by parameter 26.04 SPEED FEED PCTRL.

9 = PROF VEL: Profile velocity control. Used e.g. with CANOpen profile. Torque reference is 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block. Speed reference is 4.20 SPEED FEED FWD, which is the output of the POS CONTROL firmware block. Speed reference source can be changed by parameter 26.04 SPEED FEED PCTRL.

34.04 EXT1 CTRL MODE2

Selects the control mode 2 for external control location EXT1.

For selections, see parameter 34.03 EXT1 CTRL MODE1.

34.05 EXT2 CTRL MODE1

Selects the control mode for external control location EXT2.

For selections, see parameter 34.03 EXT1 CTRL MODE1.

34.07 LOCAL CTRL MODE

Selects the control mode for local control.

Note: This parameter cannot be changed while the drive is running.

1 = SPEED: Speed control. Torque reference is 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block. Torque reference source can be changed by parameter 34.08 TREF SPEED SRC.

2 = TORQUE: Torque control. Torque reference is 3.11 TORQ REF RUSHLIM, which is the output of the TORQ REF MOD firmware block. Torque reference source can be changed by parameter 34.08 TREF SPEED SRC.

Note: Selection 6 is only for positioning applications.

6 = POSITION: Position control. Torque reference is 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block. Speed reference is 4.01 SPEED REF POS, which is the output of the POS CONTROL firmware block. Speed reference source can be changed by parameter 26.03 SPEED REF PCTRL.

34.08 TREF SPEED SRC

Selects the source for the torque reference (from the speed controller). Default value is P.3.8, i.e. 3.08 TORQ REF SP CTRL, which is the output of the SPEED CONTROL firmware block.

Note: This parameter has been locked, i.e. no user setting is possible.

Value pointer: Group and index

34.09 TREF TORQ SRC

Selects the source for the torque reference (from the torque reference chain). Default value is P.3.11, i.e. 3.11 TORQ REF RUSHLIM, which is the output of the TORQ REF MOD firmware block.

Note: This parameter has been locked, i.e. no user setting is possible.

Value pointer: Group and index

34.10 TORQ REF ADD SRC

Selects the source for the torque reference added to the torque value after the torque selection. Default value is P.3.12, i.e. 3.12 TORQUE REF ADD, which is the output of the TORQ REF SEL firmware block.

Note: This parameter has been locked, i.e. no user setting is possible.

Value pointer: Group and index

Outputs

3.13 TORQ REF TO TC

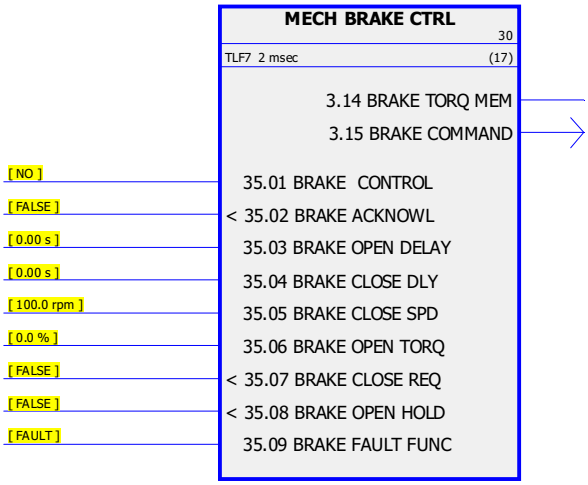
Torque reference in % for the torque control. When 99.05 MOTOR CTRL MODE = SCALAR, this value is forced to 0.

6.12 OP MODE ACK

Operation mode acknowledge: 0 = STOPPED, 1 = SPEED, 2 = TORQUE, 3 = MIN, 4 = MAX, 5 = ADD, 6 = POSITION, 7 = SYNCHRON, 8 = HOMING, 9 = PROF VEL, 10 = SCALAR, 11 = FORCED MAGN (i.e. DC Hold).

MECH BRAKE CTRL

(30)



Description

With the MECH BRAKE CTRL block the user can adjust the mechanical brake control and brake supervision.

This block also shows the torque value stored when the brake close command is issued and the value of the brake command.

The mechanical brake is used for holding the motor and driven machinery at zero speed when the drive is stopped, or not powered.

Example

The figure below shows a brake control application example.

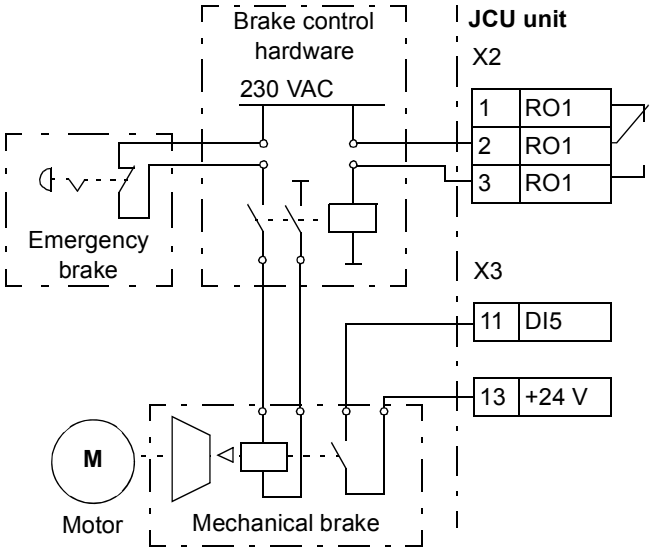
WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfils the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered as a safety device mentioned in the European Machinery Directive and related harmonised standards. Thus, the personnel safety of the complete machinery must not be based on a specific frequency converter feature (such as the brake control function), but it has to be implemented as defined in the application specific regulations.

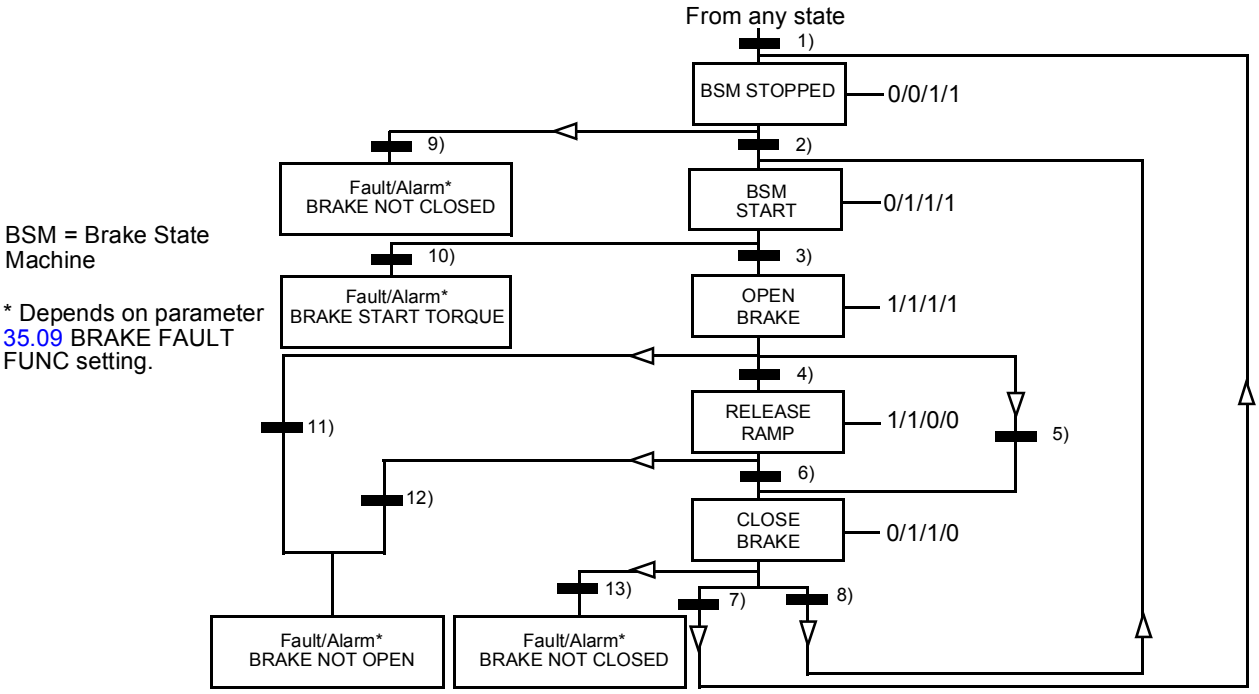
The brake on/off is controlled via signal 3.15 BRAKE COMMAND. The source for the brake supervision is selected by parameter 35.02 BRAKE ACKNOWL.

The brake control hardware and wirings need to be done by the user.

- Brake on/off control through selected relay/digital output.
- Brake supervision through selected digital input.
- Emergency brake switch in the brake control circuit.

- Brake on/off control through relay output (i.e. parameter 12.12 RO1 OUT PTR setting is P.3.15 = 3.15 BRAKE COMMAND).
- Brake supervision through digital input DI5 (i.e. parameter 35.02 BRAKE ACKNOWL setting is P.2.1.4 = 2.01 DI STATUS bit 4)





State (Symbol NN W/X/Y/Z)

- NN: State name
- W/X/Y/Z: State outputs/operations

W: 1 = Brake open command is active. 0 = Brake close command is active. (Controlled through selected digital/relay output with signal 3.15 BRAKE COMMAND.)

X: 1 = Forced start (inverter is modulating). The function keeps the internal Start on until the brake is closed in spite of the status of the external Stop. Effective only when ramp stop has been selected as the stop mode (11.03 STOP MODE). Run enable and faults override the forced start. 0 = No forced start (normal operation).

Y: 1 = Drive control mode is forced to speed/scalar.

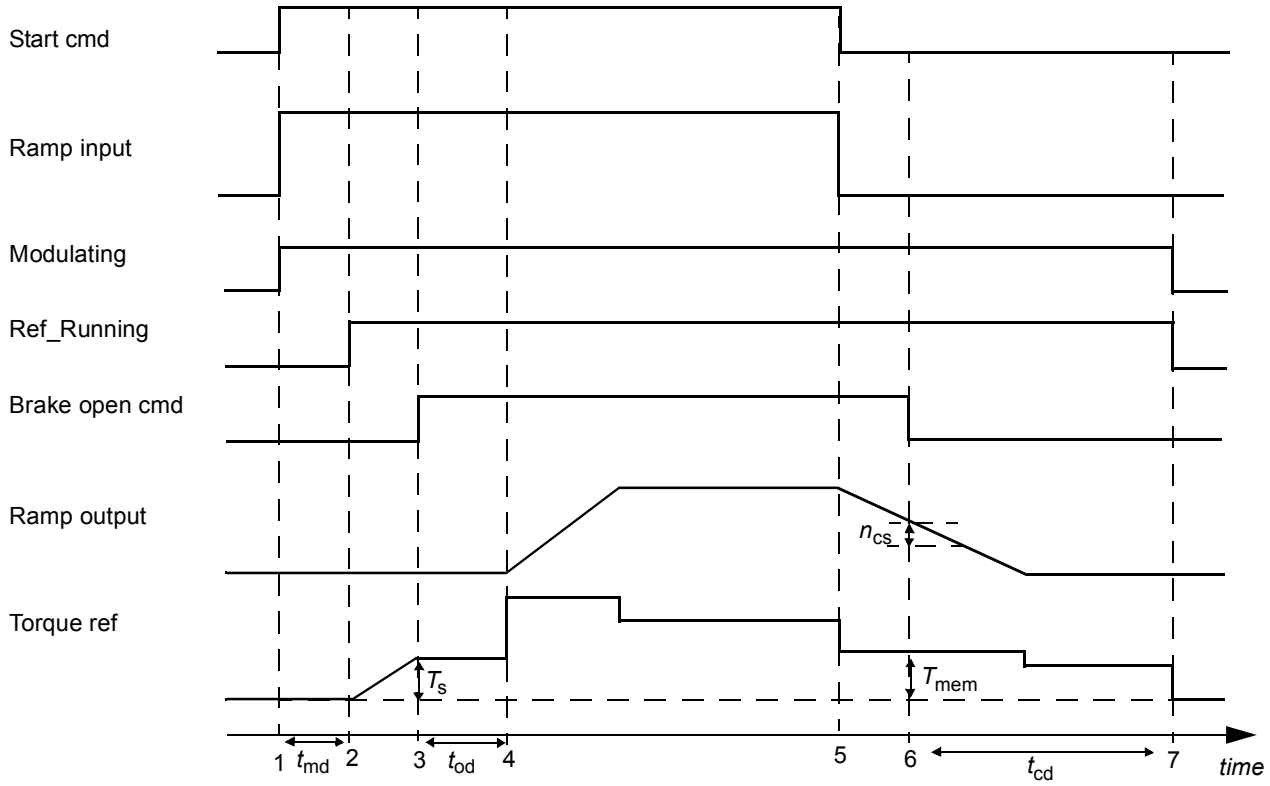
Z: 1 = Ramp generator output is forced to zero. 0 = Ramp generator output is enabled (normal operation).

State change conditions (Symbol ▬)

1) Brake control is active (35.01 BRAKE CONTROL = 1/2) OR modulation of the drive is requested to stop. The drive control mode is forced to speed/scalar.
2) External start command is on AND brake open request is on (35.07 BRAKE CLOSE REQ = 0).
3) Starting torque required at brake release is reached (35.06 BRAKE OPEN TORQ) AND brake hold is not active (35.08 BRAKE OPEN HOLD). **Note:** With scalar control, the defined starting torque has no effect.
4) Brake is open (acknowledgement = 1, selected by par. 35.02 BRAKE ACKNOWL) AND the brake open delay has passed (35.03 BRAKE OPEN DELAY). Start = 1.
5) 6) Start = 0 OR brake close command is active AND actual motor speed < brake close speed (35.05 BRAKE CLOSE SPD).
7) Brake is closed (acknowledgement = 0) AND brake close delay has passed (35.04 BRAKE CLOSE DLY). Start = 0.
8) Start = 1.
9) Brake is open (acknowledgement = 1) AND brake close delay has passed.
10) Defined starting torque at brake release is not reached.
11) Brake is closed (acknowledgement = 0) AND brake open delay has passed.
12) Brake is closed (acknowledgement = 0).
13) Brake is open (acknowledgement = 1) AND brake close delay has passed.

Operation time scheme

The time scheme below illustrates the operation of the brake control function (simplified).



T_s	Start torque at brake release (parameter 35.06 BRAKE OPEN TORQ)
T_{mem}	Stored torque value at brake close (signal 3.14 BRAKE TORQ MEM)
t_{md}	Motor magnetising delay
t_{od}	Brake open delay (parameter 35.03 BRAKE OPEN DELAY)
n_{cs}	Brake close speed (parameter 35.05 BRAKE CLOSE SPD)
t_{cd}	Brake close delay (parameter 35.04 BRAKE CLOSE DLY)

Inputs

35.01 BRAKE CONTROL

Activates the brake control function with or without supervision.

Note: This parameter cannot be changed while the drive is running.

0 = NOT USED: Inactive

1 = WITH ACK: Brake control with supervision (supervision is activated by par. 35.02 BRAKE ACKNOWL).

2 = NO ACK: Brake control without supervision

35.02 BRAKE ACKNOWL

Selects the source for the external brake on/off supervision activation (when par. 35.01 BRAKE CONTROL = WITH ACK). The use of the external on/off supervision signal is optional. 1 = The brake is open. 0 = The brake is closed.

Brake supervision is usually controlled with a digital input. It can also be controlled with an external control system, e.g. fieldbus.

When brake control error is detected the drive reacts as defined by parameter 35.09 BRAKE FAULT FUNC.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

35.03 BRAKE OPEN DELAY

Defines the brake open delay (= the delay between the internal open brake command and the release of the motor speed control). The delay counter starts when the drive has magnetised the motor and risen the motor torque to the level required at the brake release (parameter 35.06 BRAKE OPEN TORQ). Simultaneously with the counter start, the brake function energises the relay output controlling the brake and the brake starts opening.

Set the delay the same as the mechanical opening delay of the brake specified by the brake manufacturer.

Range: 0…5 s

35.04 BRAKE CLOSE DLY

Defines the brake close delay. The delay counter starts when the motor actual speed has fallen below the set level (parameter 35.05 BRAKE CLOSE SPD) after the drive has received the stop command. Simultaneously with the counter start, the brake control function de-energises the relay output controlling the brake and the brake starts closing. During the delay, the brake function keeps the motor live preventing the motor speed from falling below zero.

Set the delay time to the same value as the mechanical make-up time of the brake (= operating delay when closing) specified by the brake manufacturer.

Range: 0…60 s

35.05 BRAKE CLOSE SPD

Defines the brake close speed (an absolute value). See parameter 35.04 BRAKE CLOSE DLY.

Range: 0…1000 rpm

35.06 BRAKE OPEN TORQ

Defines the motor starting torque at brake release (in percent of the motor nominal torque).

Range: 0…1000%

35.07 BRAKE CLOSE REQ

Selects the source for the brake close (open) request. 1 = Brake close request. 0 = Brake open request.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

35.08 BRAKE OPEN HOLD

Selects the source for the activation of the brake open command hold. 1 = Hold active. 0 = Normal operation.

Note: This parameter cannot be changed while the drive is running.

Bit pointer: Group, index and bit

35.09 BRAKE FAULT FUNC

Defines how the drive reacts in case of mechanical brake control error. If brake control supervision has not been activated by parameter 35.01 BRAKE CONTROL, this parameter is disabled.

0 = FAULT: The drive trips on fault BRAKE NOT CLOSED / BRAKE NOT OPEN if the status of the optional external brake acknowledgement signal does not meet the status presumed by the brake control function. The drive trips on fault BRAKE START TORQUE if the required motor starting torque at brake release is not achieved.

1 = ALARM: The drive generates alarm BRAKE NOT CLOSED / BRAKE NOT OPEN if the status of the optional external brake acknowledgement signal does not meet the status presumed by the brake control function. The drive generates alarm BRAKE START TORQUE if the required motor starting torque at brake release is not achieved.

2 = OPEN FLT: The drive trips on fault BRAKE NOT CLOSED / BRAKE NOT OPEN if the status of the optional external brake acknowledgement signal does not meet the status presumed by the brake control function during the opening of the brake. Other brake function errors generate alarm BRAKE NOT CLOSED / BRAKE NOT OPEN.

Outputs

3.14 BRAKE TORQ MEM

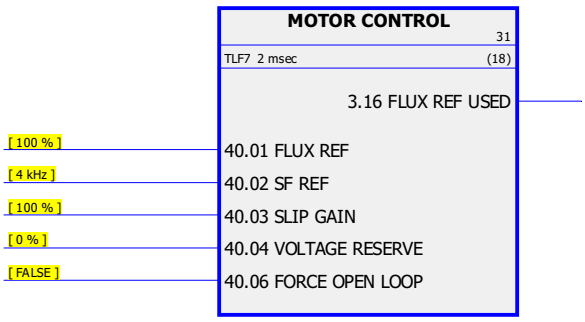
Torque value (in %) stored when the mechanical brake close command is issued.

3.15 BRAKE COMMAND

Brake on/off command. 0 = Close. 1 = Open. For brake on/off control, connect this signal to a relay output (can also be connected to a digital output). See the Example on page *118*.

MOTOR CONTROL

(31)



Description

With the MOTOR CONTROL block the user can adjust the following motor control variables:

- flux reference
- drive switching frequency
- motor slip compensation
- voltage reserve
- flux optimisation (not supported yet).

This block also shows the used flux reference value.

Flux optimisation

Note: Flux optimisation is not supported yet.

Flux optimisation reduces the total energy consumption and motor noise level when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1% to 10%, depending on the load torque and speed.

Note: Flux optimisation limits the dynamic control performance of the drive because with a small flux reference the drive torque cannot be increased fast.

Inputs

40.01 FLUX REF

Defines the flux reference.

Range: 0…200%

40.02 SF REF

Defines the switching frequency of the drive.

When switching frequency exceeds 4 kHz, the allowed drive output current is limited. See switching frequency derating in the appropriate hardware manual.

Range: 1/2/3/4/5/8/16 kHz

40.03 SLIP GAIN

Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite of the full slip gain.

Example (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite of the full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased. At the 105% gain value, no static speed error exists (2 rpm / 40 rpm = 5%).

Range: 0…200%

40.04 VOLTAGE RESERVE

Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area.

If the intermediate circuit DC voltage U_{dc} = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is

0.95 × 550 V / sqrt(2) = 369 V

The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier.

Range: x…x V/%

40.05 FLUX OPTIMIZATION

Note: Flux optimisation is not supported yet.

Activates the flux optimisation function. Optimises the motor flux by minimising the motor losses and reducing motor noise. Flux optimisation is used in drives that usually operate below nominal load.

1 = Active

0 = Inactive

40.06 FORCE OPEN LOOP

Defines the speed/position information used by the motor model.

0 = FALSE: Motor model uses the speed feedback selected by parameter 22.01 SPEED FB SEL.

1 = TRUE: Motor model uses the internal speed estimate (even when parameter 22.01 SPEED FB SEL setting is ENC1 SPEED / ENC2 SPEED).

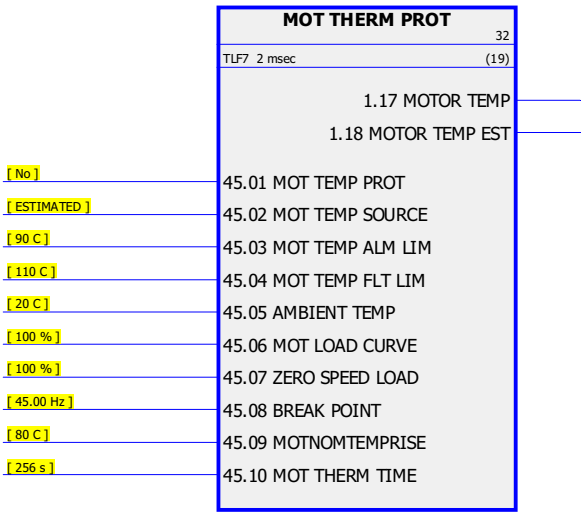
Outputs

3.16 FLUX REF USED

Used flux reference in percent

MOT THERM PROT

(32)



Description

With the MOT THERM PROT block the user can set up the motor overtemperature protection and configure motor temperature measurement (if present). This block also shows the estimated and measured motor temperature.

The motor can be protected against overheating by

- the motor thermal protection model
- measuring the motor temperature with PTC or KTY84 sensors. This will result in a more accurate motor model.

Motor thermal protection model

The drive calculates the temperature of the motor on the basis of the following assumptions:

1) When power is applied to the drive for the first time, the motor is at ambient temperature (defined by parameter 45.05 AMBIENT TEMP). After this, when power is applied to the drive, the motor is assumed to be at the estimated temperature (value of 1.18 MOTOR TEMP EST saved at power switch off).

2) Motor temperature is calculated using the user-adjustable motor thermal time and motor load curve. The load curve should be adjusted in case the ambient temperature exceeds 30 °C.

It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

Note: The motor thermal model can be used when only one motor is connected to the inverter.

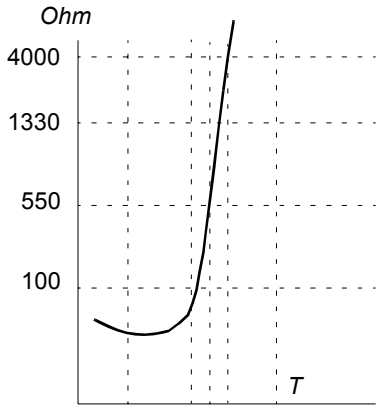
Temperature sensors

It is possible to detect motor overtemperature by connecting a motor temperature sensor to thermistor input TH of the drive or to optional encoder interface module FEN-xx.

Constant current is fed through the sensor. The resistance of the sensor increases as the motor temperature rises over the sensor reference temperature T_{ref}, as does the voltage over the resistor. The temperature measurement function reads the voltage and converts it into ohms.

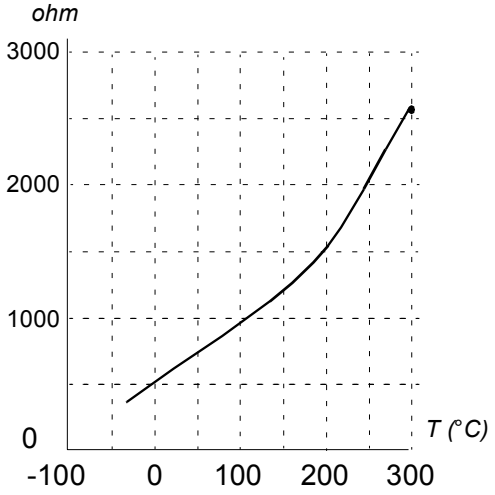
The figure below shows typical PTC sensor resistance values as a function of the motor operating temperature.

Temperature	PTC resistance
Normal	0…1.5 kohm
Excessive	≥ 4 kohm



The figure below shows typical KTY84 sensor resistance values as a function of the motor operating temperature.

KTY84 scaling
90 °C = 936 ohm
110 °C = 1063 ohm
130 °C = 1197 ohm
150 °C = 1340 ohm

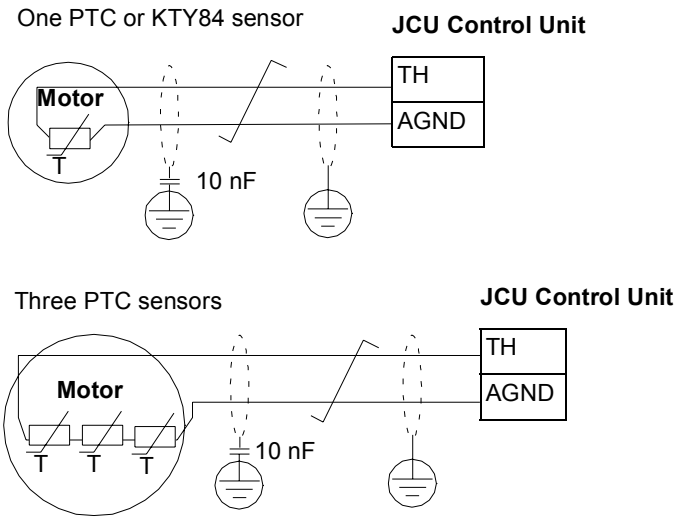


It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

WARNING! As the thermistor input on the JCU Control Unit is not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfil the requirement,
- the I/O board terminals must be protected against contact and must not be

connected to other equipment
or
- the temperature sensor must be isolated from the I/O terminals.

The figure below shows a motor temperature measurement when thermistor input TH is used.



For encoder interface module FEN-xx connection, see the User's Manual of the appropriate encoder interface module.

Inputs

45.01 MOT TEMP PROT

Selects how the drive reacts when motor overtemperature is detected.

0 = NO: Inactive

1 = ALARM: The drive generates alarm MOTOR TEMPERATURE when the temperature exceeds the alarm level defined by parameter 45.03 MOT TEMP ALM LIM.

2 = FAULT: The drive generates alarm MOTOR TEMPERATURE or trips on fault MOTOR OVERTEMP when the temperature exceeds the alarm/fault level defined by parameter 45.03 MOT TEMP ALM LIM / 45.04 MOT TEMP FLT LIM.

45.02 MOT TEMP SOURCE

Selects the motor temperature protection. When overtemperature is detected the drive reacts as defined by parameter 45.01 MOT TEMP PROT.

0 = ESTIMATED: The temperature is supervised based on the motor thermal protection model, which uses the motor thermal time constant (parameter 45.10 MOT THERM TIME) and the motor load curve (parameters 45.06…45.08). User tuning is typically needed only if the ambient temperature differs from the normal operating temperature specified for the motor.

The motor temperature increases if it operates in the region above the motor load curve. The motor temperature decreases if it operates in the region below the motor load curve (if the motor is overheated).

WARNING! The model does not protect the motor if it does not cool properly due to dust and dirt.

1 = KTY JCU: The temperature is supervised using a KTY84 sensor connected to drive thermistor input TH.

2 = KTY 1st FEN: The temperature is supervised using a KTY84 sensor connected to encoder interface module FEN-xx installed in drive Slot 1/2. If two encoder interface modules are used, encoder module connected to Slot 1 is used for the temperature supervision. **Note:** This selection does not apply for FEN-01. *

3 = KTY 2nd FEN: The temperature is supervised using a KTY84 sensor connected to encoder interface module FEN-xx installed in drive Slot 1/2. If two encoder interface modules are used, encoder module connected to Slot 2 is used for the temperature supervision. **Note:** This selection does not apply for FEN-01. *

4 = PTC JCU: The temperature is supervised using 1…3 PTC sensors connected to drive thermistor input TH.

5 = PTC 1st FEN: The temperature is supervised using a PTC sensor connected to encoder interface module FEN-xx installed in drive Slot 1/2. If two encoder interface modules are used, encoder module connected to Slot 1 is used for the temperature supervision. *

6 = PTC 2nd FEN: The temperature is supervised using a PTC sensor connected to encoder interface module FEN-xx installed in drive Slot 1/2. If two encoder interface modules are used, encoder module connected to Slot 2 is used for the temperature supervision. *

***Note:** If one FEN-xx module is used, parameter setting must be either KTY 1st FEN or PTC 1st FEN. The FEN-xx module can be in either Slot 1 or Slot 2.

45.03 MOT TEMP ALM LIM

Defines the alarm limit for the motor overtemperature protection (when par. 45.01 MOT TEMP PROT = ALARM/FAULT).

Range: 0…200 °C

45.04 MOT TEMP FLT LIM

Defines the fault limit for the motor overtemperature protection (when par. 45.01 MOT TEMP PROT = FAULT).

Range: 0…200 °C

45.05 AMBIENT TEMP

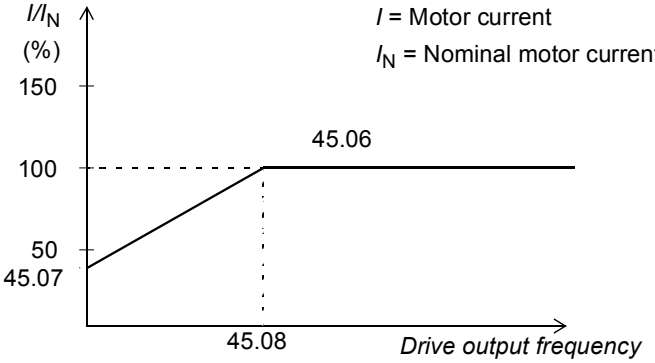
Defines the ambient temperature for the thermal protection mode.

Range: -60…100 °C

45.06 MOT LOAD CURVE

Defines the load curve together with parameters 45.07 ZERO SPEED LOAD and 45.08 BREAK POINT.

When parameter is set to 100%, the maximum load is equal to the value of the parameter 99.06 MOT NOM CURRENT (higher loads heat up the motor). The load curve level should be adjusted if the ambient temperature differs from the nominal value.



The load curve is used by the motor thermal protection model when parameter 45.02 MOT TEMP SOURCE setting is ESTIMATED.

Range: 50…150% (in percent of the nominal motor current)

45.07 ZERO SPEED LOAD

Defines the load curve together with parameters 45.06 MOT LOAD CURVE and 45.08 BREAK POINT. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations.

The load curve is used by the motor thermal protection model when parameter 45.02 MOT TEMP SOURCE setting is ESTIMATED.

Range: 50…150% (in percent of the nominal motor current)

45.08 BREAK POINT

Defines the load curve together with parameters 45.06 MOT LOAD CURVE and 45.07 ZERO SPEED LOAD. Defines the break point frequency of the load curve i.e. the point at which the motor load curve begins to decrease from the value of parameter 45.06 MOT LOAD CURVE to the value of parameter 45.07 ZERO SPEED LOAD.

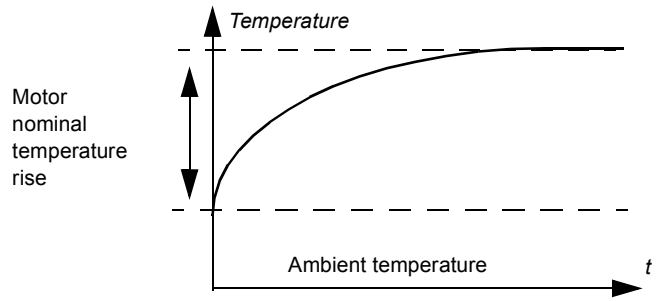
The load curve is used by the motor thermal protection model when parameter 45.02 MOT TEMP SOURCE setting is ESTIMATED.

Range: 0.01…500 Hz

45.09 MOTNOMTEMPRISE

Defines the temperature rise of the motor when the motor is loaded with nominal current. See the motor manufacturer's recommendations.

The temperature rise value is used by the motor thermal protection model when parameter 45.02 MOT TEMP SOURCE setting is ESTIMATED.

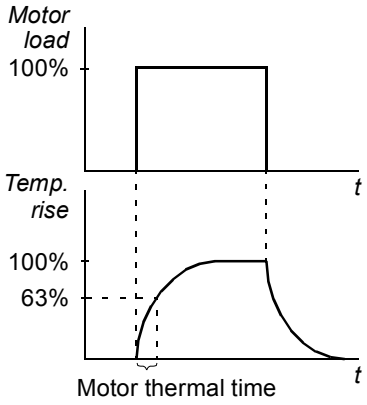


Range: 0…300 °C

45.10 MOT THERM TIME

Defines the thermal time constant for the motor thermal protection model (i.e. time inside which the temperature has reached 63% of the nominal temperature). See the motor manufacturer's recommendations.

The motor thermal protection model is used when parameter 45.02 MOT TEMP SOURCE setting is ESTIMATED.



Range: 100…10000 s

Outputs

1.17 MOTOR TEMP

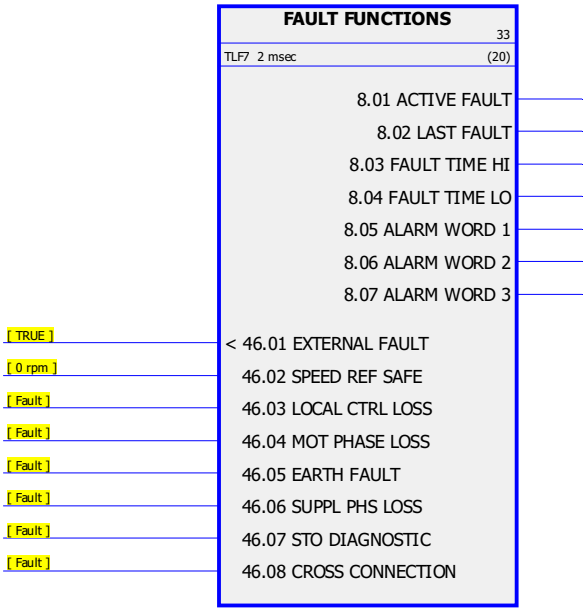
Measured motor temperature in Celsius

1.18 MOTOR TEMP EST

Estimated motor temperature in Celsius

FAULT FUNCTIONS

(33)



Description

With the FAULT FUNCTIONS block the user can

- supervise external faults by defining e.g. a digital input as a source for external fault indication signal
- select the reaction of the drive (alarm; fault; continuation at safe speed in some cases) upon situations like local control communication break, motor/supply phase loss, earth fault, or Safe Torque Off function activation.

The block also shows the codes of the latest faults, the time at which the active fault occurred and the 16-bit alarm words.

An alarm or a fault message indicates abnormal drive status. For the possible causes and remedies, see chapter Fault tracing.

Inputs

46.01 EXTERNAL FAULT

Selects an interface for an external fault signal. 0 = External fault trip. 1 = No external fault.

Bit pointer: Group, index and bit

46.02 SPEED REF SAFE

Defines the fault speed. Used as a speed reference when an alarm occurs when parameter *13.12* AI SUPERVISION / *46.03* LOCAL CTRL LOSS / *50.02* COMM LOSS FUNC setting is SPD REF SAFE.

Range: -30000…30000 rpm

46.03 LOCAL CTRL LOSS

Selects how the drive reacts to a control panel or PC tool communication break.

0 = NO: Inactive

1 = FAULT: Drive trips on fault LOCAL CTRL LOSS.

2 = SPD REF SAFE: The drive generates alarm LOCAL CTRL LOSS and sets the speed to the speed defined by parameter *46.02* SPEED REF SAFE.

WARNING! Make sure that it is safe to continue operation in case of a communication break.

3 = LAST SPEED: The drive generates alarm LOCAL CTRL LOSS and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds.

WARNING! Make sure that it is safe to continue operation in case of a communication break.

46.04 MOT PHASE LOSS

Selects how the drive reacts when a motor phase loss is detected.

0 = NO: Inactive

1 = FAULT: The drive trips on fault MOTOR PHASE.

46.05 EARTH FAULT

Selects how the drive reacts when an earth fault or current unbalance is detected in the motor or the motor cable.

0 = NO: Inactive.

1 = WARNING: The drive generates alarm EARTH FAULT.

2 = FAULT: The drive trips on fault EARTH FAULT.

46.06 SUPPL PHS LOSS

Selects how the drive reacts when a supply phase loss is detected.

0 = NO: Inactive

1 = FAULT: The drive trips on fault SUPPLY PHASE.

46.07 STO DIAGNOSTIC

Selects how the drive reacts when the drive detects that the Safe Torque Off function is active while the drive is stopped. The Safe Torque Off function disables the control voltage of the power semiconductors of the drive output stage, thus preventing the inverter from generating the voltage required to rotate the motor. For Safe torque Off wiring, see the appropriate hardware manual.

Note: This parameter is only for supervision. The Safe Torque Off function can activate, even when this parameter selection is NO.

Note: Fault STO 1 LOST / STO 2 LOST is activated if safety circuit signal 1/2 is lost when the drive is at stopped state and parameter 46.07 STO DIAGNOSTIC setting is ALARM or NO.

1 = FAULT: Drive trips on fault SAFE TORQUE OFF.

2 = ALARM: Drive generates alarm SAFE TORQUE OFF.

3 = NO: Inactive.

46.08 CROSS CONNECTION

Selects how the drive reacts to incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).

0 = NO: Inactive.

1 = FAULT: Drive trips on fault CABLE CROSS CON.

Outputs

8.01 ACTIVE FAULT

Fault code of the latest (active) fault

8.02 LAST FAULT

Fault code of the 2nd latest fault

8.03 FAULT TIME HI

Time (real time or power-on time) at which the active fault occurred in format dd.mm.yy (=day.month.year)

8.04 FAULT TIME LO

Time (real time or power-on time) at which the active fault occurred in format hh.mm.ss (hours.minutes.seconds)

8.05 ALARM WORD 1

Alarm word 1. For possible causes and remedies, see chapter Fault tracing.

Bit	Alarm
0	BRAKE START TORQUE
1	BRAKE NOT CLOSED
2	BRAKE NOT OPEN
3	SAFE TORQUE OFF
4	STO MODE CHANGE
5	MOTOR TEMPERATURE
6	EMERGENCY OFF
7	RUN ENABLE
8	ID-RUN
9	EMERGENCY STOP
10	POSITION SCALING
11	BR OVERHEAT
12	BC OVERHEAT
13	DEVICE OVERTEMP
14	INTBOARD OVERTEMP
15	BC MOD OVERTEMP

8.06 ALARM WORD 2

Alarm word 2. For possible causes and remedies, see chapter Fault tracing.

Bit	Alarm
0	IGBT OVERTEMP
1	FIELDBUS COMM
2	LOCAL CTRL LOSS
3	AI SUPERVISION
3…15	Reserved

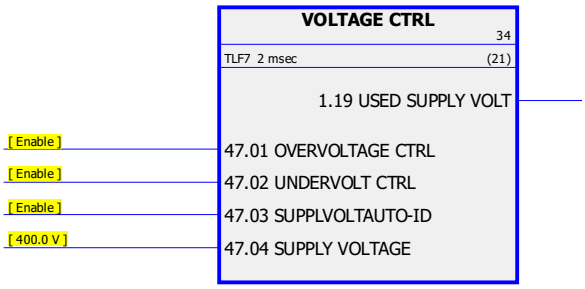
8.07 ALARM WORD 3

Alarm word 3. For possible causes and remedies, see chapter Fault tracing.

Bit	Alarm
0…15	Reserved

VOLTAGE CTRL

(34)



Description

With the VOLTAGE CTRL block the user can activate the overvoltage and undervoltage controllers, enable the auto-identification of the supply voltage and define the nominal supply voltage.

This block also shows the supply voltage used by the charging control of the drive.

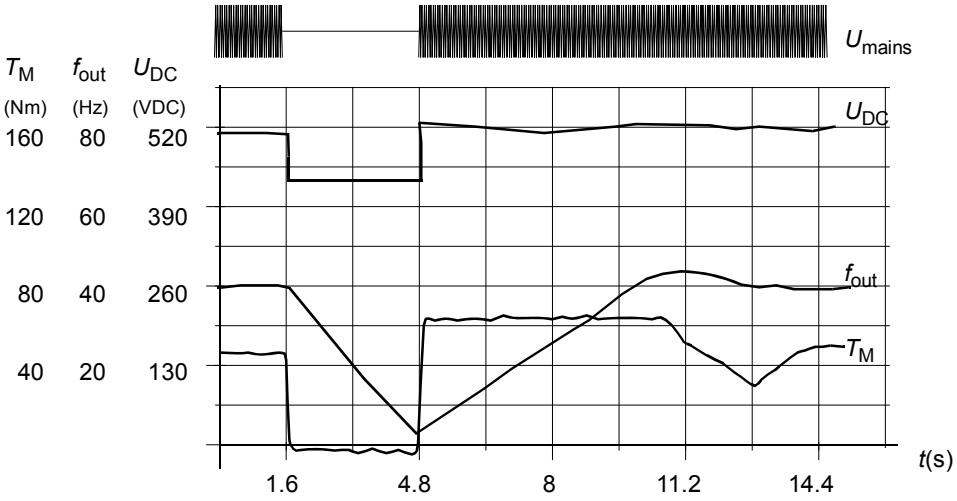
Overvoltage control

Overvoltage control of the intermediate DC link is needed with two-quadrant line-side converters when the motor operates within the generating quadrant. To prevent the DC voltage from exceeding the overvoltage control limit, the overvoltage controller automatically decreases the generating torque when the limit is reached.

Undervoltage control

If the incoming supply voltage is cut off, the drive will continue to operate by utilising the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive. The drive can continue the operation after the break if the main contactor remained closed.

Note: Units equipped with main contactor option must be equipped with a hold circuit (e.g. UPS) which keeps the contactor control circuit closed during a short supply break.

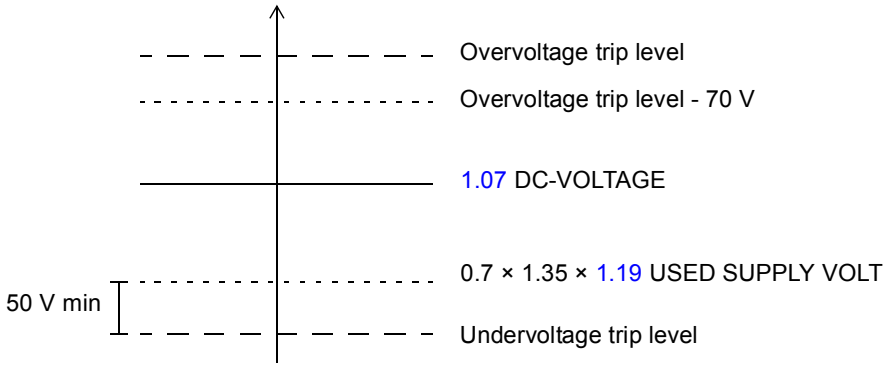


U_{DC}= intermediate circuit voltage of the drive, f_{out} = output frequency of the drive, T_M = motor torque

Loss of supply voltage at nominal load (f_{out} = 40 Hz). The intermediate circuit DC voltage drops to the minimum limit. The controller keeps the voltage steady as long as the mains is switched off. The drive runs the motor in generator mode. The motor speed falls but the drive is operational as long as the motor has enough kinetic energy.

Undervoltage and overvoltage control limits

The undervoltage limit depends on the supply voltage as defined by parameters 47.04 SUPPLY VOLTAGE and 47.03 SUPPLVOLTAUTO-ID.


Overvoltage trip level
Overvoltage trip level - 70 V
1.07 DC-VOLTAGE
0.7 × 1.35 × 1.19 USED SUPPLY VOLT
50 V min
Undervoltage trip level

Auto-identification

The intermediate DC circuit charging is based on the measured DC voltage. If the measured voltage falls below the control limit, the intermediate circuit is charged. If the measured voltage exceeds the control limit, the intermediate circuit is discharged.

The control limit is either a user-defined limit (47.04 SUPPLY VOLTAGE) or it is determined by the voltage auto-identification (47.03 SUPPLVOLTAUTO-ID). In voltage auto-identification the nominal input line voltage is determined from the actual DC bus level. The function is useful in avoiding excessive inrush currents after a voltage dip.

The control limit used currently used by the drive is shown by signal 1.19 USED SUPPLY VOLT.

Inputs

47.01 OVERVOLTAGE CTRL

Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque.

Note: If a brake chopper and resistor or a regenerative supply section are included in the drive, the controller must be deactivated.

0 = DISABLE

1 = ENABLE

47.02 UNDERVOLT CTRL

Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan.

0 = DISABLE

1 = ENABLE

47.03 SUPPLVOLTAUTO-ID

Enables the auto-identification of the supply voltage.

0 = DISABLE

1 = ENABLE

47.04 SUPPLY VOLTAGE

Defines the nominal supply voltage. Used if auto-identification of the supply voltage is not enabled by parameter 47.03 SUPPLVOLTAUTO-ID.

Range: 0…1000 V

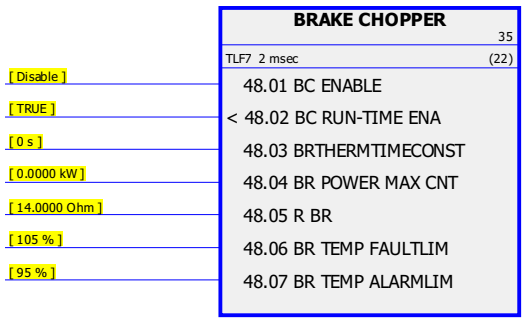
Outputs

1.19 USED SUPPLY VOLT

Either the nominal supply voltage defined by parameter 47.04 SUPPLY VOLTAGE, or the automatically determined supply voltage if auto-identification is enabled by parameter 47.03 SUPPLVOLTAUTO-ID.

BRAKE CHOPPER

(35)



Description

With the BRAKE CHOPPER BLOCK the user can adjust the brake chopper control and supervision.

Inputs

48.01 BC ENABLE

Enables the brake chopper control.

0 = DISABLE

1 = ENABLE. **Note:** Ensure the brake resistor is installed and the overvoltage control is switched off (parameter 47.01 OVERVOLTAGE CTRL). The drive has a built-in brake chopper.

48.02 BC RUN-TIME ENA

Selects the source for quick run-time brake chopper control. 0 = Brake chopper IGBT pulses are cut off. 1 = Normal brake chopper IGBT modulation. The overvoltage control is automatically switched off.

This parameter can be used to program the chopper control to function only when the drive is operating in the generator mode.

Bit pointer: Group, index and bit

48.03 BRTHERMTIMECONST

Defines the thermal time constant of the brake resistor. The value is used in the overload protection.

Range: 0…10000 s

48.04 BR POWER MAX CNT

Defines the maximum continuous braking power which will raise the resistor temperature to the maximum allowed value. The value is used in the overload protection.

Range: 0…10000 kW

48.05 R BR

Defines the resistance value of the brake resistor. The value is used for brake chopper protection.

Range: 0.1…1000 ohm

48.06 BR TEMP FAULTLIM

Selects the fault limit for the brake resistor temperature supervision. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter 48.04 BR POWER MAX.

When the limit is exceeded the drive trips on fault BR OVERHEAT.

Range: 0…150%

48.07 BR TEMP ALARMLIM

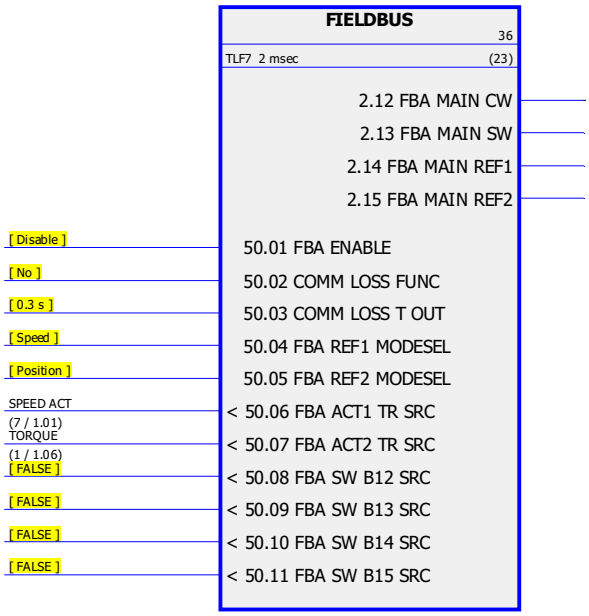
Selects the alarm limit for the brake resistor temperature supervision. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter 48.04 BR POWER MAX.

When limit is exceeded the drive generates alarm BR OVERHEAT.

Range: 0…150%

FIELDBUS

(36)


FIELDBUS
36
TLF7 2 msec
(23)
2.12 FBA MAIN CW
2.13 FBA MAIN SW
2.14 FBA MAIN REF1
2.15 FBA MAIN REF2
[Disable]
[No]
[0.3 s]
[Speed]
[Position]
SPEED ACT
(7 / 1.01)
TORQUE
(1 / 1.06)
[FALSE]
[FALSE]
[FALSE]
[FALSE]
50.01 FBA ENABLE
50.02 COMM LOSS FUNC
50.03 COMM LOSS T OUT
50.04 FBA REF1 MODESEL
50.05 FBA REF2 MODESEL
< 50.06 FBA ACT1 TR SRC
< 50.07 FBA ACT2 TR SRC
< 50.08 FBA SW B12 SRC
< 50.09 FBA SW B13 SRC
< 50.10 FBA SW B14 SRC
< 50.11 FBA SW B15 SRC

Description

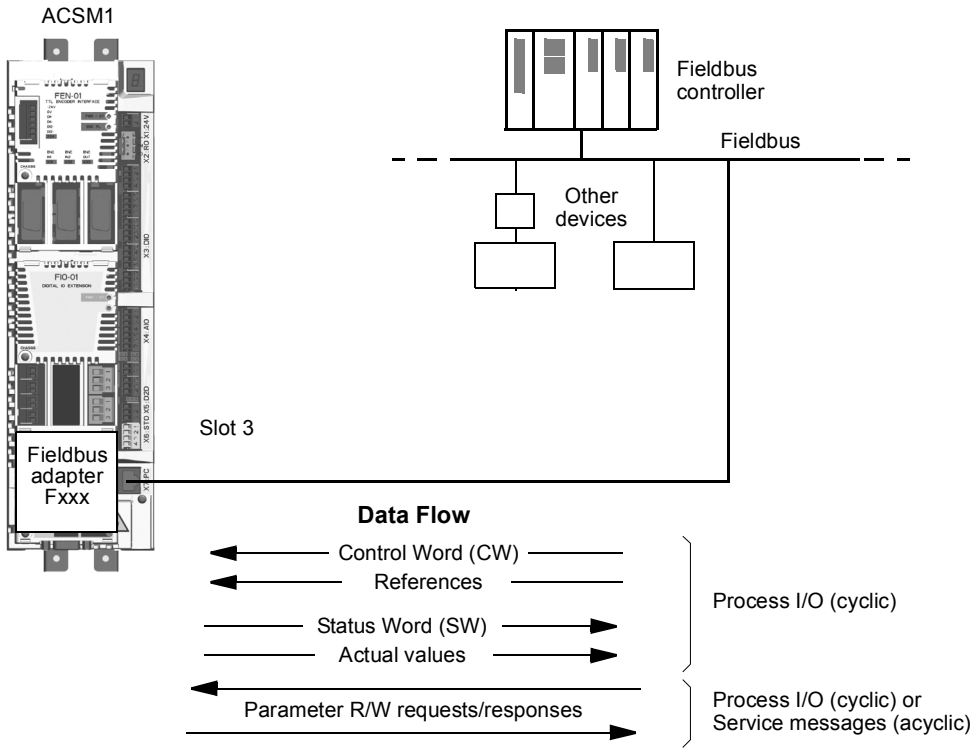
With the FIELDBUS block the user can initialise the fieldbus communication and select the used communication supervision.

The block also shows the fieldbus status and control words and fieldbus references 1 and 2.

The following description introduces the fieldbus communication and instructs in setting up the fieldbus communication.

Fieldbus communication

The drive can be connected to a fieldbus controller via a fieldbus adapter module. The adapter module is connected to drive Slot 3.



The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the fieldbus interface and other available sources, for example digital and analogue inputs.

The drive can communicate with fieldbus controller via fieldbus adapter using one of the following serial communication protocols:

- PROFIBUS-DP® (FPBA-01 adapter)
- CANopen® (FCAN-01 adapter)
- DeviceNet® (FDNA-01 adapter).

Setting up communication through a fieldbus adapter module

Before configuring the drive for fieldbus control, the adapter module must be mechanically and electrically installed according to the instructions given in the User's Manual of the appropriate fieldbus adapter module.

The communication between the drive and the fieldbus adapter module is activated by setting parameter 50.01 FBA ENABLE to ENABLE. The adapter-specific parameters must also be set. See the table below.

Parameter	Setting for fieldbus control	Function/Information
COMMUNICATION INITIALISATION AND SUPERVISION (firmware block FIELDBUS)		
50.01 FBA ENABLE	(1) ENABLE	Initialises communication between drive and fieldbus adapter module.
50.02 COMM LOSS FUNC	(0) NO (1) FAULT (2) SPD REF SAFE (3) LAST SPEED	Selects how the drive reacts in a fieldbus communication break.
50.03 COMM LOSS T OUT	0.3…6553.5 s	Defines the time between communication break detection and the action selected with parameter 50.02 COMM LOSS FUNC.
50.04 FBA REF1 MODESEL and 50.05 FBA REF2 MODESEL	(0) RAW DATA (1) TORQUE (2) SPEED (3) POSITION (4) VELOCITY	Defines the fieldbus reference scaling. When RAW DATA is selected, see also parameters 50.06…50.11. Selections POSITION and VELOCITY are for positioning applications only.
ADAPTER MODULE CONFIGURATION (firmware block FBA SETTINGS)		
51.01 FBA TYPE	–	Displays the type of the fieldbus adapter module.
51.02 FBA PAR 2	These parameters are adapter module-specific. For more information, see the User's Manual of the fieldbus adapter module. Note that not all of these parameters are necessarily used.	
• • •		
51.26 FBA PAR 26		
51.27 FBA PAR REFRESH	(0) DONE (1) REFRESH	Validates any changed adapter module configuration parameter settings.
51.28 PAR TABLE VER	–	Displays the parameter table revision of the fieldbus adapter module mapping file stored in the memory of the drive.
51.29 DRIVE TYPE CODE	–	Displays the drive type code of the fieldbus adapter module mapping file stored in the memory of the drive.
51.30 MAPPING FILE VER	–	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive.
51.31 D2FBA COMM STA	–	Displays the status of the fieldbus adapter module communication.
51.32 FBA COMM SW VER	–	Displays the common program revision of the adapter module.
51.33 FBA APPL SW VER	–	Displays the application program revision of the adapter module.
Note: In the User's Manual of the fieldbus adapter module the parameter group number is 1 for parameters 51.01…51.26.		

Parameter	Setting for fieldbus control	Function/Information
TRANSMITTED DATA SELECTION (firmware blocks FBA DATA IN and FBA DATA OUT)		
52.01…52.12 FBA DATA IN1…12	0 1…6 11…16 101…9999	Defines the data transmitted from drive to fieldbus controller. **Note:** If the selected data is 32 bits long, two parameters are reserved for the transmission.
53.01…53.12 FBA DATA OUT1…12	0 1…3 11…13 1001…9999	Defines the data transmitted from fieldbus controller to drive. **Note:** If the selected data is 32 bits long, two parameters are reserved for the transmission.
Note: In the User's Manual of the fieldbus adapter module the parameter group number is 3 for parameters 52.01…52.12 and 2 for parameters 53.01…53.12.		

After the module configuration parameters have been set, the drive control parameters (see section Drive control parameters) must be checked and adjusted when necessary.

The new settings will take effect when the drive is powered up again, or when parameter 51.27 FBA PAR REFRESH is activated.

Drive control parameters

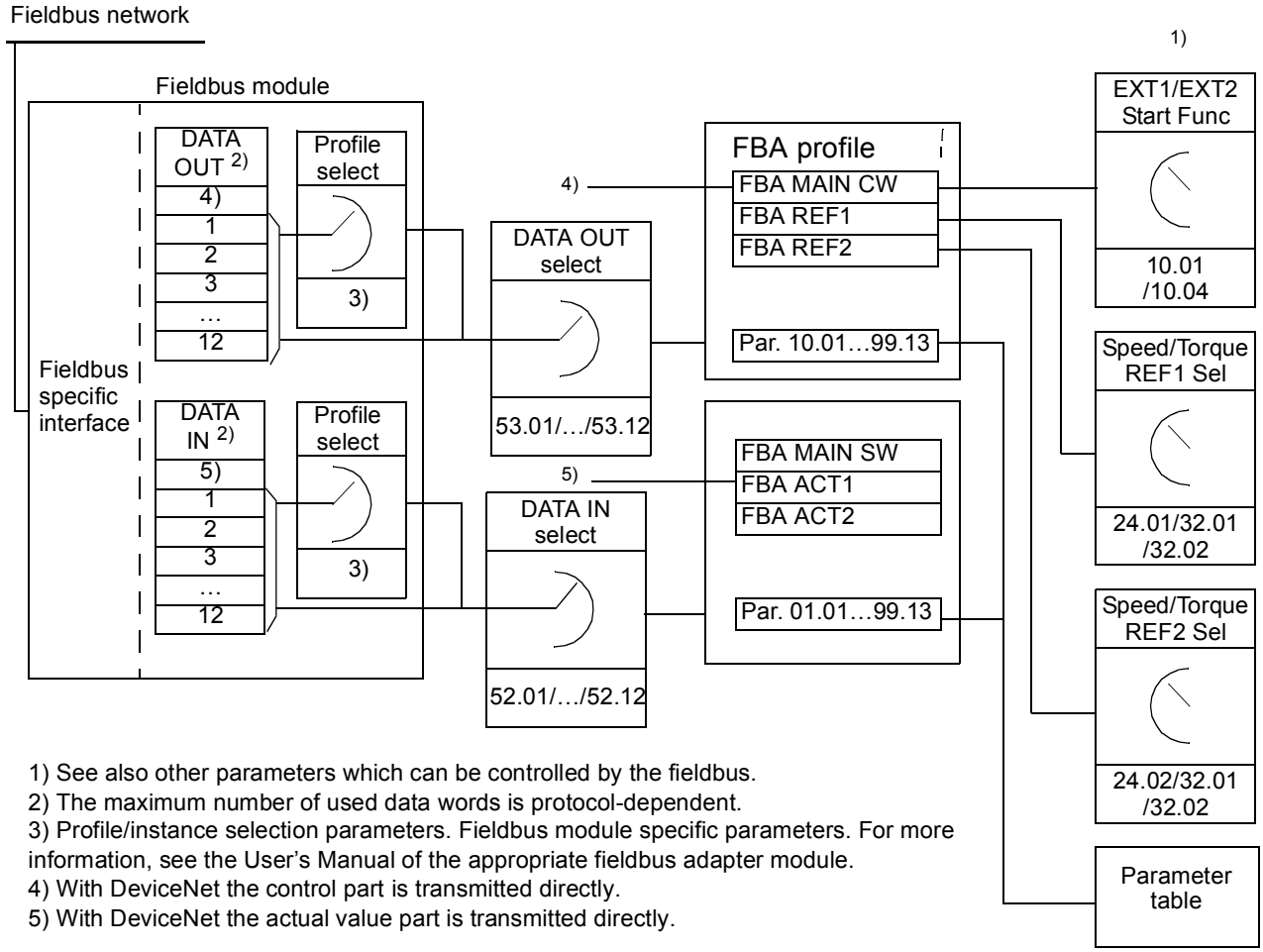
The Setting for fieldbus control column gives the value to use when the fieldbus interface is the desired source or destination for that particular signal. The Function/Information column gives a description of the parameter.

Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
10.01 EXT1 START FUNC	(3) FBA	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
10.04 EXT2 START FUNC	(3) FBA	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
24.01 SPEED REF1 SEL	(3) FBA REF1 (4) FBA REF2	Fieldbus reference REF1 or REF2 is used as speed reference 1.
24.02 SPEED REF2 SEL	(3) FBA REF1 (4) FBA REF2	Fieldbus reference REF1 or REF2 is used as speed reference 2.
32.01 TORQ REF1 SEL	(3) FBA REF1 (4) FBA REF2	Fieldbus reference REF1 or REF2 is used as torque reference 1.
32.02 TORQ REF ADD SEL	(3) FBA REF1 (4) FBA REF2	Fieldbus reference REF1 or REF2 is used for torque reference addition.
SYSTEM CONTROL INPUTS		
16.07 PARAM SAVE	(0) DONE (1) SAVE	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

The fieldbus control interface

The communication between a fieldbus system and the drive consists of 16/32-bit input and output data words. The drive supports at the maximum the use of 12 data words (16-bit) in each direction.

Data transmitted from the drive to the fieldbus controller is defined by parameters 52.01…52.12 (FBA DATA IN) and data transmitted from the fieldbus controller to the drive is defined by parameters 53.01…53.12 (FBA DATA OUT).



1) See also other parameters which can be controlled by the fieldbus.
2) The maximum number of used data words is protocol-dependent.
3) Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the User's Manual of the appropriate fieldbus adapter module.
4) With DeviceNet the control part is transmitted directly.
5) With DeviceNet the actual value part is transmitted directly.

The Control Word and the Status Word

The Control Word (CW) is the principal means of controlling the drive from a fieldbus system. The Control Word is sent by the fieldbus controller to the drive. The drive switches between its states according to the bit-coded instructions of the Control Word.

The Status Word (SW) is a word containing status information, sent by the drive to the fieldbus controller.

Actual Values

Actual Values (ACT) are 16/32-bit words containing information on selected operations of the drive.

FBA communication profile

The FBA communication profile is a state machine model which describes the general states and state transitions of the drive. The State diagram on page *148* presents the most important states (including the FBA profile state names). The FBA Control Word commands the transitions between these states and the FBA Status Word indicates the status of the drive.

Fieldbus adapter module profile (selected by adapter module parameter) defines how the control word and status word are transmitted in a system which consists of fieldbus controller, fieldbus adapter module and drive. With transparent modes, control word and status word are transmitted without any conversion between the fieldbus controller and the drive. With other profiles (e.g. PROFIdrive for FPBA-01, AC/DC drive for FDNA-01, DS-402 for FCAN-01 and ABB Drives profile for all fieldbus adapter modules) fieldbus adapter module converts the fieldbus-specific control word to the FBA communication profile and status word from FBA communication profile to the fieldbus-specific status word.

For descriptions of other profiles, see the User's Manual of the appropriate fieldbus adapter module.

Fieldbus references

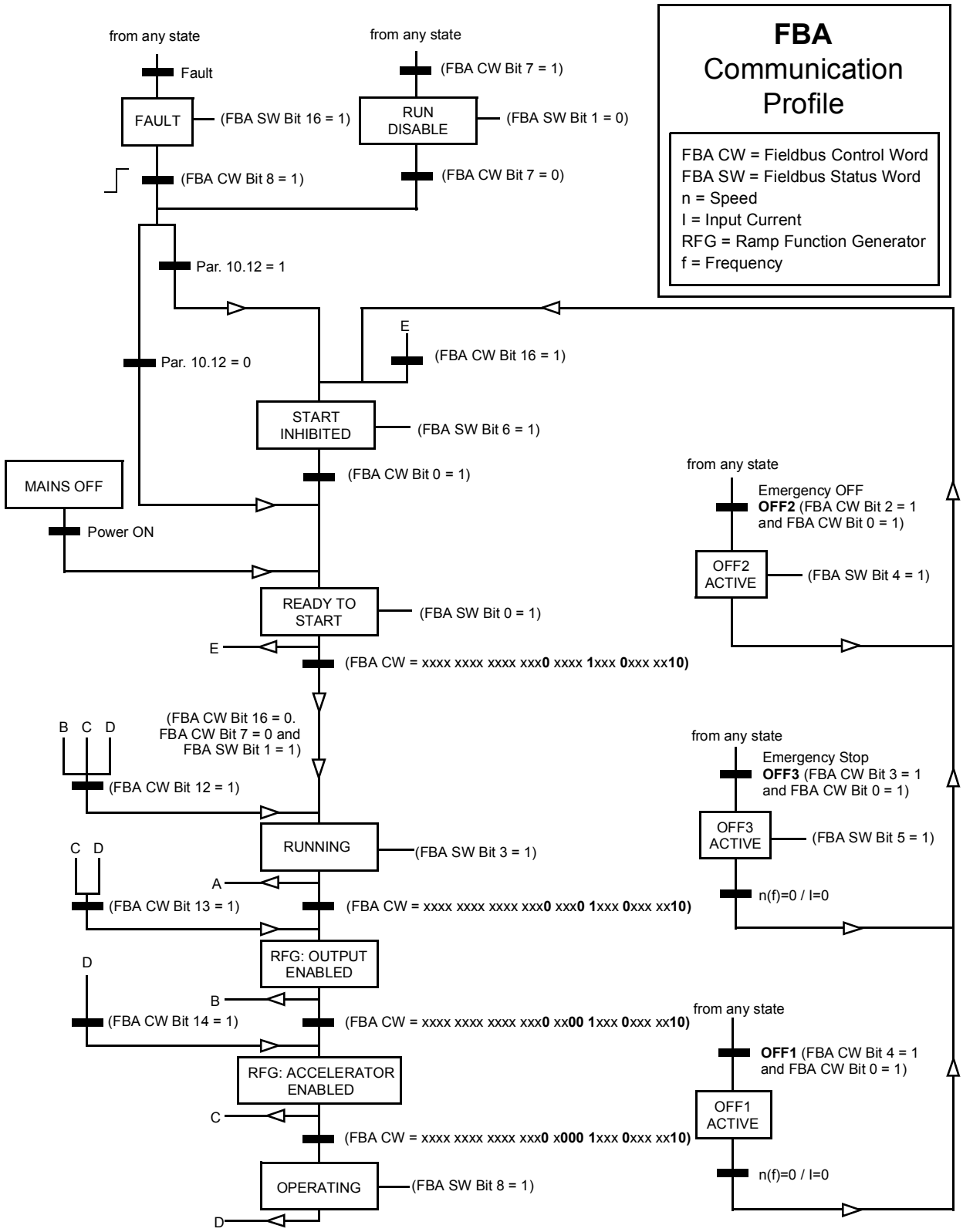
References (FBA REF) are 16/32-bit signed integers. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference value. The contents of each reference word can be used as torque or speed reference.

When torque or speed reference scaling is selected (by parameter 50.04 FBA REF1 MODESEL / 50.05 FBA REF2 MODESEL), the fieldbus references are 32-bit integers. The value consists of a 16-bit integer value and a 16-bit fractional value. The speed/torque reference scaling is as follows:

Reference	Scaling	Notes
Torque reference	FBA REF / 65536 (value in %)	Final reference is limited by parameters 20.06 MAXIMUM TORQUE and 20.07 MINIMUM TORQUE.
Speed reference	FBA REF / 65536 (value in rpm)	Final reference is limited by parameters 20.01 MAXIMUM SPEED, 20.02 MINIMUM SPEED and 24.12 SPEED REFMIN ABS.
Position reference	(In position applications only.). See the firmware block POS FEEDBACK.	
Velocity reference		

State diagram

The following presents the state diagram for the FBA communication profile. For other profiles, see the User's Manual of the appropriate fieldbus adapter module.


FBA
Communication
Profile
FBA CW = Fieldbus Control Word
FBA SW = Fieldbus Status Word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
from any state
Fault
FAULT
(FBA SW Bit 16 = 1)
(FBA CW Bit 8 = 1)
from any state
(FBA CW Bit 7 = 1)
RUN DISABLE
(FBA SW Bit 1 = 0)
(FBA CW Bit 7 = 0)
Par. 10.12 = 1
Par. 10.12 = 0
E
(FBA CW Bit 16 = 1)
START INHIBITED
(FBA SW Bit 6 = 1)
(FBA CW Bit 0 = 1)
MAINS OFF
Power ON
from any state
Emergency OFF
OFF2 (FBA CW Bit 2 = 1 and FBA CW Bit 0 = 1)
OFF2 ACTIVE
(FBA SW Bit 4 = 1)
READY TO START
(FBA SW Bit 0 = 1)
E
(FBA CW = xxxx xxxx xxxx xxx0 xxxx 1xxx 0xxx xx10)
B C D
(FBA CW Bit 16 = 0. FBA CW Bit 7 = 0 and FBA SW Bit 1 = 1)
(FBA CW Bit 12 = 1)
from any state
Emergency Stop
OFF3 (FBA CW Bit 3 = 1 and FBA CW Bit 0 = 1)
OFF3 ACTIVE
(FBA SW Bit 5 = 1)
n(f)=0 / I=0
C D
RUNNING
(FBA SW Bit 3 = 1)
A
(FBA CW Bit 13 = 1)
(FBA CW = xxxx xxxx xxxx xxx0 xxx0 1xxx 0xxx xx10)
D
RFG: OUTPUT ENABLED
B
(FBA CW Bit 14 = 1)
(FBA CW = xxxx xxxx xxxx xxx0 xx00 1xxx 0xxx xx10)
from any state
OFF1 (FBA CW Bit 4 = 1 and FBA CW Bit 0 = 1)
OFF1 ACTIVE
n(f)=0 / I=0
RFG: ACCELERATOR ENABLED
C
(FBA CW = xxxx xxxx xxxx xxx0 x000 1xxx 0xxx xx10)
OPERATING
(FBA SW Bit 8 = 1)
D

Inputs

50.01 FBA ENABLE

Enables communication between the drive and fieldbus adapter.

0 = DISABLE: No communication.

1 = ENABLE: The communication between drive and fieldbus adapter is enabled.

50.02 COMM LOSS FUNC

Selects how the drive reacts in a fieldbus communication break. The time delay is defined by parameter 50.03 COMM LOSS T OUT.

0 = NO: Protection is not active.

1 = FAULT: Protection is active. The drive trips on fault FIELDBUS COMM and coasts to stop.

2 = SPD REF SAFE: Protection is active. The drive generates alarm FIELDBUS COMM and sets the speed to the value defined by parameter 46.02 SPEED REF SAFE.

WARNING! Make sure that it is safe to continue operation in case of a communication break.

3 = LAST SPEED: Protection is active. The drive generates alarm FIELDBUS COMM and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds.

WARNING! Make sure that it is safe to continue operation in case of a communication break.

50.03 COMM LOSS T OUT

Defines the time delay before the action defined by parameter 50.02 COMM LOSS FUNC is taken. Time count starts when the link fails to update the message.

Range: 0.3…6553.5 s

50.04 FBA REF1 MODESEL

Selects the fieldbus reference FBA REF1 scaling and the actual value, which is sent to the fieldbus (FBA ACT1).

0 = RAW DATA: No scaling (i.e. data is transmitted without scaling). Source for the actual value, which is sent to the fieldbus, is selected by parameter 50.06 FBA ACT TR SRC.

1 = TORQUE: Fieldbus adapter module uses torque reference scaling. Torque reference scaling is defined by the used fieldbus profile (e.g. with ABB Drives Profile integer value 10000 corresponds to 100% torque value). Signal 1.06 TORQUE is sent to the fieldbus as an actual value. See the User's Manual of the appropriate fieldbus adapter module.

2 = SPEED: Fieldbus adapter module uses speed reference scaling. Speed reference scaling is defined by the used fieldbus profile (e.g. with ABB Drives Profile integer value 20000 corresponds to parameter 25.02 SPEED SCALING value). Signal 1.01 SPEED ACT is sent to the fieldbus as an actual value. See the User's Manual of the appropriate fieldbus adapter module.

Note: Selections 3 and 4 are only for positioning applications.

3 = POSITION: Fieldbus adapter module uses position reference scaling. Position reference scaling is defined by parameters 60.05 POS UNIT and 60.08 POS2INT SCALE. Signal 1.12 POS ACT is sent to the fieldbus as an actual value.

4 = VELOCITY: Fieldbus adapter module uses position speed scaling. Position speed scaling is defined by parameters 60.10 POS SPEED UNIT and 60.11 POS SPEED2INT. Signal 4.02 SPEED ACT LOAD is sent to the fieldbus as an actual value.

50.05 FBA REF2 MODESEL

Selects the fieldbus reference FBA REF2 scaling.

See parameter 50.05 FBA REF1 MODESEL

50.06 FBA ACT1 TR SRC

Selects the source for fieldbus actual value 1 when parameter 50.04/50.05 FBA REF1/2 MODESEL setting is RAW DATA.

Value pointer: Group and index

50.07 FBA ACT2 TR SRC

Selects the source for fieldbus actual value 2 when parameter 50.04/50.05 FBA REF1/2 MODESEL setting is RAW DATA.

Value pointer: Group and index

50.08 FBA SW B12 SRC

Selects the source for freely programmable fieldbus status word bit 28 (2.13 FBA MAIN SW bit 28 SW B1212).

Bit pointer: Group, index and bit

50.09 FBA SW B13 SRC

Selects the source for freely programmable fieldbus status word bit 29 (2.13 FBA MAIN SW bit 29 SW B13).

Bit pointer: Group, index and bit

50.10 FB ASW B14 SRC

Selects the source for freely programmable fieldbus status word bit 30 (2.13 FBA MAIN SW bit 30 SW B14).

Bit pointer: Group, index and bit

50.11 FBA SW B15 SRC

Selects the source for freely programmable fieldbus status word bit 31 (2.13 FBA MAIN SW bit 31 SW B15).

Bit pointer: Group, index and bit

Outputs

2.12 FBA MAIN CW

Control Word for fieldbus communication.

Log. = Logical combination (i.e. Bit AND/OR Selection parameter). Par. = Selection parameter. See State diagram on page *148*.

Bit	Name	Val.	Information	Log.	Par.
0	STOP*	1	Stop according to the stop mode selected by 11.03 STOP MODE or according to the requested stop mode (bits 2…6). **Note:** Simultaneous STOP and START commands result in a stop command.	OR	10.02, 10.03, 10.05, 10.06
		0	No operation		
1	START	1	Start. **Note:** Simultaneous STOP and START commands result in a stop command.	OR	10.02, 10.03, 10.05, 10.06
		0	No operation		
2	STPMODE EM OFF*	1	Emergency OFF2 (bit 0 must be 1): Drive is stopped by cutting off the motor power supply (the inverter IGBTs are blocked). The motor coasts to stop. The drive will restart only with the next rising edge of the start signal when the run enable signal is on.	AND	-
		0	No operation		
3	STPMODE EM STOP*	1	Emergency stop OFF3 (bit 0 must be 1): Stop within the time defined by 25.11 EM STOP TIME.	AND	10.10
		0	No operation		
4	STPMODE OFF1*	1	Emergency stop OFF1 (bit 0 must be 1): Stop along the currently active deceleration ramp.	AND	10.11
		0	No operation		
5	STPMODE RAMP*	1	Stop along the currently active deceleration ramp.	-	11.03
		0	No operation		
6	STPMODE COAST*	1	Coast to stop.	-	11.03
		0	No operation		
7	RUN ENABLE	1	Activate run enable.	AND	10.09
		0	Activate run disable.		
8	RESET	0->1	Fault reset if an active fault exists.	OR	10.08
		other	No operation		
* If all stop mode bits 2…6 are 0, stop mode is selected by 11.03 STOP MODE. Coast stop (bit 6) overrides the emergence stop (bit 2/3/4). Emergency stop overrides the normal ramp stop (bit 5).					

Bit	Name	Val.	Information	Log.	Par.
9	JOGGING 1	1	Activate jogging function 1. See section Jogging on page *64*.	OR	10.07
		0	Jogging function 1 disabled		
10	JOGGING 2	1	Activate jogging function 2. See section Jogging on page *64*.	-	-
		0	Jogging function 2 disabled		
11	REMOTE CMD	1	Fieldbus control enabled	-	-
		0	Fieldbus control disabled		
12	RAMP OUT 0	1	Force Ramp Function Generator output to 0. Drive ramps to a stop (current and DC voltage limits in force).	-	-
		0	No operation		
13	RAMP HOLD	1	Halt ramping (Ramp Function Generator output held).	-	-
		0	No operation		
14	RAMP IN 0	1	Force Ramp Function Generator input to zero.	-	-
		0	No operation		
15	EXT1/EXT2	1	Switch to external control location EXT2.	OR	34.01
		0	Switch to external control location EXT1.		
16	REQ STARTINH	1	Activate start inhibit.	-	-
		0	No start inhibit		
17	LOCAL CTL	1	Request local control for Control Word. Used when the drive is controlled via PC tool or panel or through local fieldbus. - Local fieldbus: Transfer to fieldbus local control (control via fieldbus control word or reference). Fieldbus steals the control. - Panel or PC tool: Transfer to local control.	-	-
		0	Request external control.		
18	FBLOCAL REF	1	Request fieldbus local control.	-	-
		0	No fieldbus local control		

Note: Bits 19 to 26 are only for positioning applications.

Bit	Name	Val.	Information	Log.	Par.
19	ABS POSIT	1	Use absolute positioning.	OR	65.09, 65.17 bit 4
		0	Use relative positioning.		
20	POS START MODE	1	Select pulse start for positioning: Start by rising edge of a pulse.	OR	65.24
		0	Select normal start for positioning: Start by signal rising edge. The signal has to stay TRUE during the positioning task.		
21	POSITION-ING ENA	1	Enable position control.	OR	66.05
		0	Disable position control.		
22	PO REF LIM ENA	1	Enable position reference.	OR	70.03
		0	Disable position reference. Position reference speed limit is set to zero. Positioning task is rejected.		
23	Not in use				
24	CHG SET IMMED	1	Interrupt actual positioning and start next positioning.	-	-
		0	Finish actual positioning and then start next positioning.		
25	POS START	1	Activate positioning start. Operation depends on selected start mode (bit 20 POS START MODE).	OR	65.03, 65.11
		0	Deactivate positioning start.		
26	START HOMING	1	Start homing.	OR	62.03
		0	Normal operation.		
27	Not in use				
28	CW B28		Freely programmable control bits. See parameters 50.08…50.11 and the user manual of the fieldbus adapter.	-	-
29	CW B29				
30	CW B30				
31	CW B31				

2.13 FBA MAIN SW

Status Word for fieldbus communication. See State diagram on page *148*.

Bit	Name	Value	Description
0	READY	1	Drive is ready to receive start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal is received.
		0	No external run enable signal is received.
2	STARTED	1	Drive has received start command.
		0	Drive has not received start command.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	EM OFF (OFF2)	1	Emergency OFF2 is active.
		0	Emergency OFF2 is inactive.
5	EM STOP (OFF3)	1	Emergency stop OFF3 (ramp stop) is active.
		0	Emergency OFF3 is inactive.
6	ACK STARTINH	1	Start inhibit is active.
		0	Start inhibit is inactive.
7	ALARM	1	An alarm is active. See chapter Fault tracing.
		0	No alarm
8	AT SETPOINT	1	Drive is at setpoint. Actual value equals reference value (i.e. the difference between the actual speed and the speed reference is within the speed window defined by 26.07 SPEED WINDOW).
		0	Drive has not reached setpoint.
9	LIMIT	1	Operation is limited by torque limit (any torque limit).
		0	Operation is within torque limits.
10	ABOVE LIMIT	1	Actual speed exceeds the defined limit, 22.07 ABOVE SPEED LIM.
		0	Actual speed is within the defined limits.
11	EXT2 ACT	1	External control EXT2 is active.
		0	External control EXT1 is active.
12	LOCAL FB	1	Fieldbus local control is active.
		0	Fieldbus local control is inactive.
13	ZERO SPEED	1	Drive speed is below limit set by par. 22.05 ZERO SPEED LIMIT.
		0	Drive has not reached zero speed limit.
14	REV ACT	1	Drive is running in reverse direction.
		0	Drive is running in forward direction.
15	Not in use		
16	FAULT	1	Fault is active. See chapter Fault tracing.
		0	No fault
17	LOCAL PANEL	1	Local control is active, i.e. drive is controlled form PC tool or control panel.
		0	Local control is inactive.

Note: Bits 18 to 26 are only for positioning applications.

Bit	Name	Value	Description
18	FOLLOWING ERROR	1	The difference between the reference and the actual position is within the defined following error window 71.09 FOLLOW ERR WIN.
		0	The difference between the reference and the actual position is outside the defined following error window.
19	TGT REACHED	1	Target position is reached.
		0	Target position is not reached.
20	HOMING DONE	1	Homing sequence is completed.
		0	Homing sequence is not completed.
21	TRAV TASK ACK	1	New positioning task or setpoint is accepted.
		0	No operation
22	MOVING	1	Positioning task is active. Drive speed is < > 0.
		0	Positioning task is completed or drive is at standstill.
23	IP MODE ACTIVE	1	Position reference generator is active.
		0	Position reference generator is inactive.
24	REG LEVEL	1	Position latch signal 1 is active (source selected by parameter 62.15 TRIG PROBE1).
		0	Position latch signal 1 is inactive.
25	POSITIVE LIMIT	1	Positive limit switch is active (source selected by parameter 62.06 POS LIM SWITCH).
		0	Positive limit switch is inactive.
26	NEGATIVE LIMIT	1	Negative limit switch is active (source selected by parameter 62.05 NEG LIM SWITCH).
		0	Negative limit switch is inactive.
27	REQUEST CTL	1	Control word is requested from fieldbus.
		0	Control word is not requested from fieldbus.
28	SW B28		Programmable status bits (unless fixed by the used profile). See parameters 50.08…50.11 and the user manual of the fieldbus adapter.
29	SW B29		
30	SW B30		
31	SW B31		

2.14 FBA MAIN REF1

Scaled fieldbus reference 1. See parameter 50.04 FBA REF1 MODESEL.

2.15 FBA MAIN REF2

Scaled fieldbus reference 2. See parameter 50.05 FBA REF2 MODESEL.

FBA SETTINGS

Note: The FBA SETTINGS parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

With the FBA SETTINGS parameters the user can configure the fieldbus adapter module and validate changed adapter module parameter settings. FBA SETTINGS also shows fieldbus adapter module information.

Fieldbus parameters need to be adjusted only when a fieldbus adapter module (optional) is installed and activated by parameter 50.01 FBA ENABLE.

For information in setting up the fieldbus communication, see firmware block FIELDBUS on page *142*.

Parameters

For more parameter information, see the User's Manual of the fieldbus adapter module.

Notes:

- In the User's Manual, the parameter group number is 1.
- Any changes take effect only after the fieldbus interface is powered up for the next time, or after a parameter refresh command (parameter 51.27) is given.

51.01 FBA TYPE

Displays the type of the connected fieldbus adapter module.

NOT DEFINED: Fieldbus module is not found, or it is not properly connected, or parameter 50.01 FBA ENABLE setting is DISABLE.

1 = PROFIBUS-DP adapter module

2 = CANopen adapter module

3 = DeviceNet adapter module

51.02 FBA PAR2

Parameters 51.02…51.26 are adapter module-specific. For more information, see the User's Manual of the fieldbus adapter module. Note that not all of these parameters are necessarily visible.

… …. ….

51.26 FBA PAR26

Parameters 51.02…51.26 are adapter module-specific. For more information, see the User's Manual of the fieldbus adapter module. Note that not all of these parameters are necessarily visible.

51.27 FBA PAR REFRESH

Validates any changed adapter module configuration parameter settings. After refreshing, the value reverts automatically to DONE.

Note: This parameter cannot be changed while the drive is running.

0 = DONE: Refreshing done

1 = REFRESH: Refreshing

51.28 PAR TABLE VER

Displays the parameter table revision of the fieldbus adapter module mapping file stored in the memory of the drive.

In format xyz, where x = major revision number; y = minor revision number; z = correction number.

51.29 DRIVE TYPE CODE

Displays the drive type code of the fieldbus adapter module mapping file stored in the memory of the drive.

Example: 520 = ACSM1 Speed and Torque Control Program.

51.30 MAPPING FILE VER

Displays the fieldbus adapter module mapping file revision stored in the memory of the drive.

In decimal format. Example: 1 = revision 1.

51.31 D2FBA COMM STA

Displays the status of the fieldbus adapter module communication.

(0) IDLE	Adapter is not configured.
(1) EXEC. INIT	Adapter is initialising.
(2) TIME OUT	A timeout has occurred in the communication between the adapter and the drive.
(3) CONFIG ERROR	Adapter configuration error: The major or minor revision code of the common program revision in the fieldbus adapter module is not the revision required by the module (see par. 51.32) or mapping file upload has failed more than three times.
(4) OFF-LINE	Adapter is off-line.
(5) ON-LINE	Adapter is on-line
(6) RESET	Adapter is performing a hardware reset.

51.32 FBA COMM SW VER

Displays the common program revision of the adapter module.

In format axyz, where a = major revision number, xy = minor revision numbers. z = correction letter.

Example: 190A = revision 1.90A.

51.33 FBA APPL SW VER

Displays the application program revision of the adapter module.

In format axyz, where: a = major revision number, xy = minor revision numbers, z = correction letter.

Example: 190A = revision 1.90A.

FBA DATA IN

Note: The FBA DAT IN parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

With the FBA DATA IN parameters the user can select the data to be transmitted from the drive to the fieldbus controller by the input data words (16/32-bit).

The maximum number of used data words is protocol-dependent.

Fieldbus parameters need to be adjusted only when a fieldbus adapter module (optional) is installed and activated by parameter 50.01 FBA ENABLE.

For information in setting up the fieldbus communication, see firmware block FIELDBUS on page *142*.

Parameters

For more parameter information, see the User's Manual of the fieldbus adapter module.

Notes:

- In the User's Manual, the parameter group number is 3.
- Any changes take effect only after the fieldbus interface is powered up for the next time, or after a parameter refresh command (parameter 51.27) is given.

52.01 FBA DATA IN1

Selects data to be transferred from the drive to the fieldbus controller.

0: Not in use

1…6

11…16

52.01 setting	Data word
4	Status Word (16 bits)
5	Actual value 1 (16 bits)
6	Actual value 2 (16 bits)
14	Status Word (32 bits)
15	Actual value 1 (32 bits)
16	Actual value 2 (32 bits)

101…9999: Parameter index

52.02 FBA DATA IN2

See 52.01 FBA DATA IN1.

….

52.12 FBA DATA IN12

See 52.01 FBA DATA IN1.

FBA DATA OUT

Note: The FBA DATA OUT parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

With the FBA DATA OUT parameters the user can select the data to be transmitted from the fieldbus controller to the drive by the output data words (16/32-bit).

The maximum number of used data words is protocol-dependent.

Fieldbus parameters need to be adjusted only when a fieldbus adapter module (optional) is installed and activated by parameter 50.01 FBA ENABLE.

For information in setting up the fieldbus communication, see firmware block FIELDBUS on page *142*.

Inputs

For more parameter information, see the User's Manual of the fieldbus adapter module.

Notes:

- In the User's Manual, the parameter group number is 2.
- Any changes take effect only after the fieldbus interface is powered up for the next time, or after a parameter refresh command (parameter 51.27) is given.

53.01 FBA DATA OUT1

Selects data to be transferred from the fieldbus controller to the drive.

0: Not in use

0

1…3

11…13

53.01 setting	Data word
1	Control Word (16 bits)
2	REF1 (16 bits)
3	REF2 (16 bits)
11	Control Word (32 bits)
12	REF1 (32 bits)
13	REF2 (32 bits)

1001…9999: Drive parameter

53.02 FBA DATA OUT2

See 53.01 FBA DATA OUT1.

…

53.12 FBA DATA OUT12

See 53.01 FBA DATA OUT1.

D2D COMMUNICATION

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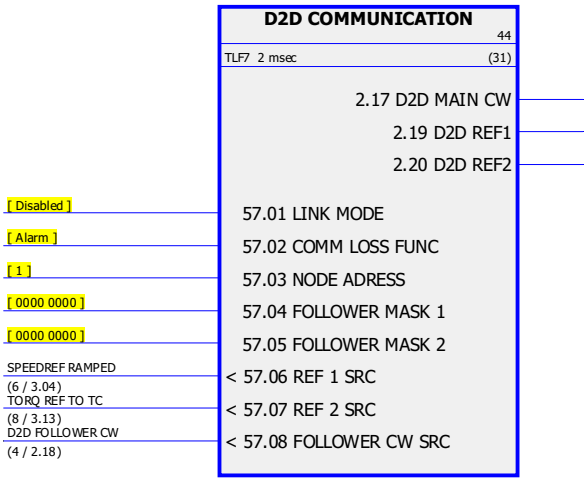


Description

With the D2D COMMUNICATION block, the user can set up the drive-to-drive communication link between multiple drives. The drive firmware supports up to 63 nodes. See page 163 for wiring details.

The drive firmware supports basic master/follower communication with one master drive and multiple followers. By default, the master provides control commands as well as speed and torque references for the followers. In positioning applications, the master can also be configured to send a position reference as either target position or synchronization reference.

The contents of the standard communication dataset (16-bit control word + two 32-bit references) can be configured freely with pointer parameters and/or solution programming with the SPC tool. Depending on the drive control mode, the followers can be configured to use the drive-to-drive commands and references with the following parameters:

Control data	Parameter	Setting for drive-to-drive communication
Start/Stop commands	10.01 EXT1 START FUNC 10.04 EXT2 START FUNC	4: D2D
Speed reference	24.01 SPEED REF1 SEL 24.02 SPEED REF2 SEL	5: D2D REF1 or 6: D2D REF2
Torque reference	32.01 TORQ REF1 SEL 32.02 TORQ REF ADD SEL	5: D2D REF1 or 6: D2D REF2
Position reference*	65.04 POS REF 1 SEL 65.12 POS REF 2 SEL	5: D2D REF1 or 6: D2D REF2
Position reference in synchron control operating mode*	67.01 SYNC REF SEL 67.02 SPEED REF VIRT M	5: D2D REF1 or 6: D2D REF2

*Only for positioning applications

The communication status of the followers is supervised by a periodic supervision message from the master to the individual followers.

Drive-to-drive function blocks can be used in the SPC tool to enable additional communication methods and to modify the use of datasets between the drives. (Not available at the time of printing.)

Inputs

57.01 LINK MODE

Activates the drive-to-drive connection.

0 = DISABLED: Drive-to-drive connection disabled.

1 = FOLLOWER: The drive is a follower on the drive-to-drive link.

2 = MASTER: The drive is the master on the drive-to-drive link. Only one drive can be the master at a time.

57.02 COMM LOSS FUNC

Selects how the drive acts when an erroneous drive-to-drive configuration or a communication break is detected.

0 = NO: Protection is not active.

1 = ALARM: The drive generates an alarm.

2 = FAULT: The drive trips on a fault.

57.03 NODE ADRESS

Sets the node address for a follower drive. Each follower must have a dedicated node address.

Note: If the drive is set to be the master on the drive-to-drive link, this parameter has no effect (the master is automatically assigned node address 0).

57.04 FOLLOWER MASK 1

On the master drive, selects the followers to be polled. If no response is received from a polled follower, the action selected by parameter 57.02 COMM LOSS FUNC is taken.

The least significant bit represents follower with node address 1, while the most significant bit represents follower 31. When a bit is set to 1, the corresponding node address is polled. For example, followers 1 and 2 are polled when this parameter is set to the value of 0x3.

57.05 FOLLOWER MASK 2

On the master drive, selects the followers to be polled. If no response is received from a polled follower, the action selected by parameter 57.02 COMM LOSS FUNC is taken.

The least significant bit represents follower with node address 32, while the most significant bit represents follower 62. When a bit is set to 1, the corresponding node address is polled. For example, followers 32 and 33 are polled when this parameter is set to the value of 0x3.

57.06 REF 1 SRC

On the master drive, selects the source of D2D reference 1 sent to the followers.

Value pointer: Group and index. The default value is P.03.04, i.e. 3.04 SPEEDREF RAMPED.

57.07 REF 2 SRC

On the master drive, selects the source of D2D reference 2 sent to the followers.

Value pointer: Group and index. The default value is P.03.13, i.e. 3.13 TORQ REF TO TC.

57.08 FOLLOWER CW SRC

On the master drive, selects the source of the D2D control word sent to the followers.

Value pointer: Group and index. The default value is P.02.18, i.e. 2.18 D2D FOLLOWER CW.

57.09 KERNEL SYNC MODE

Enables the synchronisation of firmware time levels between drives, or between a PLC or a drive.

0 = NOSYNC: No synchronisation.

1 = D2DSYNC: If the drive is a master on a drive-to-drive link, it broadcasts a synchronisation signal to the follower(s). If the drive is a follower, it synchronises its firmware time levels to the signal received from the master.

2 = FBSYNC: The drive synchronises its firmware time levels to synchronisation signal received through a fieldbus adapter.

3 = FBTOD2DSYNC: If the drive is the master on a drive-to-drive link, it synchronises its firmware time levels to synchronisation signal received from a fieldbus adapter, and broadcasts the signal on the drive-to-drive link. If the drive is a follower, synchronisation is disabled.

57.10 KERNEL SYNC OFFS

Defines an offset between the master and the followers on the drive-to-drive link. A positive value will cause the followers to lag; with a negative value, the followers will lead.

Range: -4999…5000

Outputs

2.17 D2D MAIN CW

Drive-to-drive control word received from the master. See also actual signal 2.18 on page 69.

Bit	Information
0	Stop.
1	Start.
2	Reserved.
3	Reserved.
4	Reserved.
5	Reserved.
6	Reserved.
7	Run enable. By default, not connected in a follower drive.
8	Reset. By default, not connected in a follower drive.
9	Freely assignable through bit pointer parameters.
10	Freely assignable through bit pointer parameters.
11	Freely assignable through bit pointer parameters.
12	Freely assignable through bit pointer parameters.
13	Freely assignable through bit pointer parameters.
14	Freely assignable through bit pointer parameters.
15	EXT1/EXT2 selection. 0 = EXT1 active, 1 = EXT2 active. By default, not connected in a follower drive.

2.19 D2D REF1

Drive-to-drive reference 1 received from the master.

2.20 D2D REF2

Drive-to-drive reference 2 received from the master.

Drive-to-drive link wiring

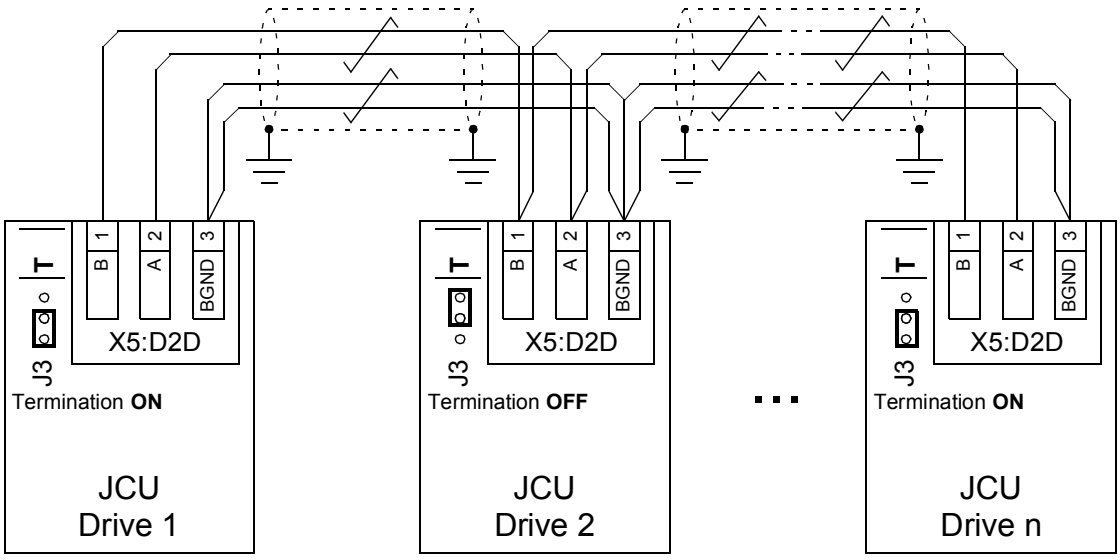
The drive-to-drive link is a daisy-chained RS-485 transmission line, constructed by connecting the X5 terminal blocks of the JCU Control Units of several drives. Shielded twisted-pair cable (~100 ohm, e.g. PROFIBUS-compatible cable) must be used for the wiring. The maximum length of the link is 50 metres (164 ft).

The JCU Control Unit has a jumper (J3, “T”) next to the X5 terminal block for bus termination. Termination must be ON on the drives at the ends of the drive-to-drive link; on intermediate drives, termination must be OFF.

For best immunity, high quality cable is recommended. The cable should be kept as short as possible. Unnecessary loops and running the cable near power cables (such as motor cables) must be avoided.

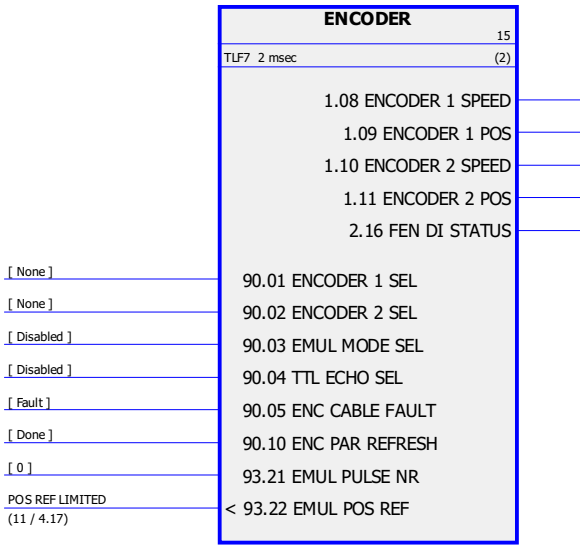
Note: The cable shields are to be grounded to the control cable clamp plate on the drive. Follow the instructions given in the *Hardware Manual* of the drive.

The following diagram shows the wiring of the drive-to-drive link.



ENCODER

(15)



Description

With the ENCODER block the user can activate the communication to encoder interface 1/2 and enable the encoder emulation/echo. The block also shows encoder 1/2 speed and actual position.

Encoder/Resolver

The firmware offers support for two encoders (or resolvers), encoder 1 and 2. Multi turn encoders are supported only as encoder 1. Three optional interface modules are available:

- TTL Encoder Interface Module FEN-01: two TTL inputs, TTL output (for encoder emulation and echo) and two digital inputs for position latching
- Absolute Encoder Interface FEN-11: absolute encoder input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs for position latching
- Resolver Interface Module FEN-21: resolver input, TTL input, TTL output (for encoder emulation echo) and two digital inputs for position latching.

The interface module is connected to drive option Slot 1 or 2. **Note:** Two encoder interface modules of the same type are not allowed.

For encoder/resolver configuration, see firmware blocks ABSOL ENC CONF on page *169*, RESOLVER CONF on page *174* and PULSE ENC CONF on page *176*.

Inputs

90.01 ENCODER 1 SEL

Activates the communication to optional encoder/resolver interface 1.

0 = NONE: Inactive

1 = FEN-01 TTL+: Communication active. Module type: FEN-01 TTL Encoder interface Module. Input: TTL encoder input with commutation support (X32). See firmware block PULSE ENC CONF on page *176*.

2 = FEN-01 TTL: Communication active. Module type: FEN-01 TTL Encoder interface Module. Input: TTL encoder input (X31). See firmware block PULSE ENC CONF on page *176*.

3 = FEN-11 ABS: Communication active. Module type: FEN-11 Absolute Encoder Interface. Input: Absolute encoder input (X42). See firmware block ABSOL ENC CONF on page *169*.

4 = FEN-11 TTL: Communication active. Module type: FEN-11 Absolute Encoder Interface. Input: TTL encoder input (X41). See firmware block PULSE ENC CONF on page *176*.

5 = FEN-21 RES: Communication active. Module type: FEN-21 Resolver Interface. Input: Resolver input (X52). See firmware block RESOLVER CONF on page *174*.

6 = FEN-21 TTL: Communication active. Module type: FEN-21 Resolver Interface. Input: TTL encoder input (X51). See firmware block PULSE ENC CONF on page *176*.

Note: It is recommended that encoder interface 1 is used whenever possible since the data received through that interface is fresher than the data received through interface 2. On the other hand, when position values used in emulation are determined by the drive software, the use of encoder interface 2 is recommended as the values are transmitted earlier through interface 2 than through interface 1.

90.02 ENCODER 2 SEL

Activates the communication to the optional encoder/resolver interface 2.

For selections, see parameter 90.01 ENCODER 1 SEL.

Note: The counting of shaft revolutions is not supported for encoder 2.

90.03 EMUL MODE SEL

Enables the encoder emulation and selects the position value and the TTL encoder output used in the emulation process.

In encoder emulation a calculated position difference is transformed to a corresponding number of TTL pulses to be transmitted via encoder TTL output. The position difference is the difference between the latest and the previous position values.

The position value used in emulation can be either a position determined by the drive software or a position measured by an encoder. If drive software position is used, the source for the used position is selected by parameter 93.22 EMUL POS REF (in firmware block PULSE ENC CONF on page *176*). Because the software causes a delay, it is recommended that actual position is always taken from an encoder. Drive software is recommended to be used only with position reference emulation.

Encoder emulation can be used to increase or decrease the pulse number when TTL encoder data is transmitted via the TTL output e.g. to another drive. If the pulse number requires no alternation, use encoder echo for data transformation. See parameter 90.04 TTL ECHO SEL. **Note:** If encoder emulation and echo are enabled for the same FEN-xx TTL output, the emulation overrides the echo.

The TTL encoder pulse number used in emulation must be defined by parameter 93.21 EMUL PULSE NR. See firmware block PULSE ENC CONF on page *176*.

0 = DISABLED

1 = FEN-01 SWREF: Module type: FEN-01 TTL Encoder interface Module. Emulation: Drive software position (source selected by par. 93.22 EMUL POS REF) is emulated to FEN-01 TTL output.

2 = FEN-01 TTL+: Module type: FEN-01 TTL Encoder interface Module. Emulation: FEN-01 TTL encoder input (X32) position is emulated to FEN-01 TTL encoder output.

3 = FEN-01 TTL: Module type: FEN-01 TTL Encoder interface Module. Emulation: FEN-01 TTL encoder input (X31) position is emulated to FEN-01 TTL encoder output.

4 = FEN-11 SWREF: Module type: FEN-11 Absolute Encoder Interface. Emulation: Drive software position (source selected by par. 93.22 EMUL POS REF) is emulated to FEN-11 TTL output.

5 = FEN-11 ABS: Module type: FEN-11 Absolute Encoder Interface. Emulation: FEN-11 absolute encoder input (X42) position is emulated to FEN-11 TTL encoder output.

6 = FEN-11 TTL: Module type: FEN-11 Absolute Encoder Interface. Emulation: FEN-11 TTL encoder input (X41) position is emulated to FEN-11:n TTL encoder output.

7 = FEN-21 SWREF: Module type: FEN-21 Resolver Interface. Emulation: Drive software position (source selected by par. 93.22 EMUL POS REF) is emulated to FEN-21 TTL output.

8 = FEN-21 RES: Module type: FEN-21 Resolver Interface. Emulation: FEN-21 resolver input (X52) position is emulated to FEN-11 TTL encoder output.

9 = FEN-21 TTL: Module type: FEN-21 Resolver Interface. Emulation: FEN-21 TTL encoder input (X51) position is emulated to FEN-21 TTL encoder output.

90.04 TTL ECHO SEL

Enables and selects the interface for the TTL encoder signal echo.

Note: If encoder emulation and echo are enabled for the same FEN-xx TTL output, the emulation overrides the echo.

0 = DISABLED

1 = FEN-01 TTL+: Module type: FEN-01 TTL Encoder interface Module. Echo: TTL encoder input (X32) pulses are echoed to the TTL encoder output.

2 = FEN-01 TTL: Module type: FEN-01 TTL Encoder interface Module. Echo: TTL encoder input (X31) pulses are echoed to the TTL encoder output.

3 = FEN-11 TTL: Module type: FEN-11 Absolute Encoder Interface. Echo: TTL encoder input (X41) pulses are echoed to the TTL encoder output.

4 = FEN-21 TTL: Module type: FEN-21 Resolver Interface. Echo: TTL encoder input (X51) pulses are echoed to the TTL encoder output.

90.05 ENC CABLE FAULT

Selects the action in case an encoder cable fault is detected by the FEN-xx encoder interface.

Note: At the time of printing, this functionality is only available with the absolute encoder input of the FEN-11 based on sine/cosine incremental signals.

0 = NO: Cable fault detection inactive.

1 = FAULT (default): The drive trips on an ENCODER 1/2 CABLE fault.

2 = WARNING: The drive generates an ENCODER 1/2 CABLE warning. This is the recommended setting if the maximum pulse frequency of sine/cosine incremental signals exceeds 100 kHz; at high frequencies, the signals may attenuate enough to invoke the function. The maximum pulse frequency can be calculated as follows:

$$\text{Maximum pulse frequency} = \frac{\text{Pulses per revolution (par. 91.01)} \times \text{Maximum speed in rpm}}{60}$$

90.10 ENC PAR REFRESH

Setting this parameter to 1 forces a reconfiguration of the FEN-xx interfaces, which is needed for any parameter changes in groups 90…93 to take effect.

The parameter is read-only when the drive is running.

0 = DONE

1 = CONFIGURE. The value will automatically revert to 0.

93.21 EMUL PULSE NR

Defines the number of TTL pulses used in encoder emulation.

Encoder emulation is enabled by parameter *90.03* EMUL MODE SEL. See firmware block *ENCODER* on page *164*.

Range: 0…65535 pulses per revolution

93.22 EMUL POS REF

Selects the source for the position value used in encoder emulation when parameter *90.03* EMUL MODE SEL setting is FEN-01 SWREF, FEN-11 SWREF or FEN-21 SWREF. See firmware block *ENCODER* on page *164*.

The source can be any actual or reference position value (except *1.09* ENCODER 1 POS and *1.11* ENCODER 2 POS).

Value pointer: Group and index. The default value is P.4.17, i.e. 4.17 POS REF LIMITED (used in positioning applications).

Outputs

1.08 ENCODER 1 SPEED

Encoder 1 speed in rpm

1.09 ENCODER 1 POS

Actual position of encoder 2 within one revolution

1.10 ENCODER 2 SPEED

Encoder 2 speed in rpm

1.11 ENCODER 2 POS

Actual position of encoder 2 within one revolution

2.16 FEN DI STATUS

Status of digital inputs of FEN-xx encoder interfaces in drive option Slots 1 and 2. Examples:
000001 (01h) = DI1 of FEN-xx in Slot 1 is ON, all others are OFF.
000010 (02h) = DI2 of FEN-xx in Slot 1 is ON, all others are OFF.
010000 (10h) = DI1 of FEN-xx in Slot 2 is ON, all others are OFF.
100000 (20h) = DI2 of FEN-xx in Slot 2 is ON, all others are OFF.

ABSOL ENC CONF

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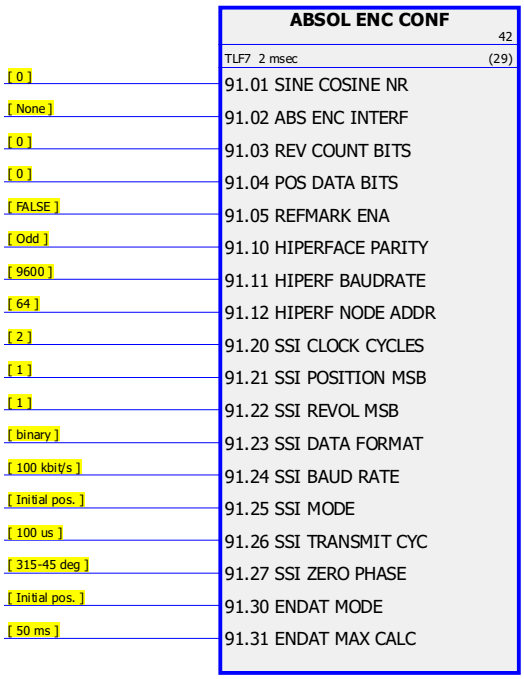


Description

With the ABSOL ENC CONF block the user can configure the absolute encoder connection.

The optional FEN-11 Absolute Encoder Interface module supports the following absolute encoders:

- Incremental sin/cos encoders with or without zero pulse and with or without sin/cos commutation signals
- Endat 2.1/2.2 with incremental sin/cos signals (partially without sin/cos incremental signals*)
- Hiperface encoders with incremental sin/cos signals
- SSI (Synchronous Serial Interface) with incremental sin/cos signals (partially without sin/cos incremental signals*).

* EnDat and SSI encoders without incremental sin/cos signals are partially supported only as encoder 1: Speed is not available and the time instant of the position data (delay) depends on the encoder.

For more information, see *Absolute Encoder Interface FEN-11 User's Manual* [3AFE68784841 (English)].

Inputs

Used when parameter *90.01*/*90.02* ENCODER 1/2 SEL setting is FEN-11 ABS.

Note: Configuration data is written into the logic registers of the adapter once after the power-up. If parameter values are changed, save values into the permanent memory by parameter *16.07* PARAM SAVE. The new settings will take effect when the drive is powered up again, or after re-configuration is forced by parameter 90.10 ENC PAR REFRESH.

91.01 SINE COSINE NR

Defines the number of sine/cosine wave cycles within one revolution.

Note: This parameter does not need to be set when EnDat or SSI encoders are used in continuous mode. See parameter *91.25* SSI MODE / *91.30* ENDAT MODE.

Range: 0…65535

91.02 ABS ENC INTERF

Selects the source for the encoder position (zero position).

0 = NONE: Not selected

1 = COMMUT SIG: Commutation signals

2 = ENDAT: Serial interface: EnDat encoder

3 = HIPERFACE: Serial interface: HIPERFACE encoder

4 = SSI: Serial interface: SSI encoder

5 = TAMAG. 17/33B: Serial interface: Tamagawa 17/33-bit encoder

91.03 REV COUNT BITS

Defines the number of bits used in revolution count (for multi turn encoders). Used with serial interfaces, i.e. when parameter *91.02* ABS ENC INTERF setting is ENDAT, HIPERFACE or SSI.

Range: 0…32. E.g. 4096 revolutions => 12 bits.

91.04 POS DATA BITS

Defines the number of bits used within one revolution. Used with serial interfaces, i.e. when parameter *91.02* ABS ENC INTERF setting is ENDAT, HIPERFACE or SSI.

Range: 0…32. E.g. 32768 positions per revolution => 15 bits.

91.05 REFMARK ENA

Enables the encoder zero pulse (if exists). Zero pulse can be used for position latching.

Note: With serial interfaces (i.e. when parameter *91.02* ABS ENC INTERF setting is ENDAT, HIPERFACE or SSI), the zero pulse must be disabled.

0 = FALSE: Disabled

1 = TRUE: Enabled

91.10 HIPERFACE PARITY

Defines the use of parity and stop bit(s) for HIPERFACE encoder (i.e. when parameter *91.02* ABS ENC INTERF setting is HIPERFACE).

Typically this parameter does not need to be set.

0 = ODD: Odd parity indication bit, one stop bit

1 = EVEN: Even parity indication bit, one stop bit

91.11 HIPERF BAUDRATE

Defines the transfer rate of the link for HIPERFACE encoder (i.e. when parameter *91.02* ABS ENC INTERF setting is HIPERFACE).

Typically this parameter does not need to be set.

0 = 4800: 4800 bits/s

1 = 9600: 9600 bits/s

2 = 19200: 19200 bits/s

3 = 38400: 38400 bits/s

91.12 HIPERF NODE ADDR

Defines the node address for HIPERFACE encoder (i.e. when parameter *91.02* ABS ENC INTERF setting is HIPERFACE).

Typically this parameter does not need to be set.

Range: 0…255

91.20 SSI CLOCK CYCLES

Defines the length of the SSI message. The length is defined as the number of clock cycles. The number of cycles can be calculated by adding 1 to the number of the bits in a SSI message frame.

Used with SSI encoders, i.e. when parameter *91.02* ABS ENC INTERF setting is SSI.

Range: 2…127

91.21 SSI POSITION MSB

Defines the location of the MSB (main significant bit) of the position data within a SSI message. Used with SSI encoders, i.e. when parameter *91.02* ABS ENC INTERF setting is SSI.

Range: Bit number 1…126

91.22 SSI REVOL MSB

Defines the location of the MSB (main significant bit) of the revolution count within a SSI message. Used with SSI encoders, i.e. when parameter *91.02* ABS ENC INTERF setting is SSI.

Range: Bit number 1…126

91.23 SSI DATA FORMAT

Selects the data format for SSI encoder (i.e. when parameter *91.02* ABS ENC INTERF setting is SSI).

0 = Binary

1 = Gray

91.24 SSI BAUD RATE

Selects the baud rate for SSI encoder (i.e. when parameter *91.02* ABS ENC INTERF setting is SSI).

0 = 10 kbit/s

1 = 50 kbit/s

2 = 100 kbit/s

3 = 200 kbit/s

4 = 500 kbit/s

5 = 1000 kbit/s

91.25 SSI MODE

Selects the SSI encoder mode.

Note: Parameter needs to be set only when an SSI encoder is used in continuous mode, i.e. SSI encoder without incremental sin/cos signals (supported only as encoder 1). SSI encoder is selected by setting parameter *91.02* ABS ENC INTERF to SSI.

0 = INITIAL POS: Single position transfer mode (initial position)

1 = CONTINUOUS: Continuous position transfer mode

91.26 SSI TRANSMIT CYC

Selects the transmission cycle for SSI encoder.

Note: This parameter needs to be set only when an SSI encoder is used in continuous mode, i.e. SSI encoder without incremental sin/cos signals (supported only as encoder 1). SSI encoder is selected by setting parameter *91.02* ABS ENC INTERF to SSI.

0 = 50 µs

1 = 100 µs

2 = 200 µs

3 = 500 µs

4 = 1 ms

5 = 2 ms

91.27 SSI ZERO PHASE

Defines the phase angle within one sine/cosine signal period that corresponds to the value of zero on the SSI serial link data. The parameter is used to adjust the synchronization of the SSI position data and the position based on sine/cosine incremental signals. Incorrect synchronization may cause an error of ±1 incremental period.

Note: This parameter needs to be set only when an SSI encoder with sine/cosine incremental signals is used in initial position mode.

0 = 315–45 deg

1 = 45–135 deg

2 = 135–225 deg

3 = 225–315 deg

91.30 ENDAT MODE

Selects the EnDat encoder mode.

Note: This parameter needs to be set only when an EnDat encoder is used in continuous mode, i.e. EnDat encoder without incremental sin/cos signals (supported only as encoder 1). EnDat encoder is selected by setting parameter *91.02* ABS ENC INTERF to ENDAT.

0 = INITIAL POS: Single position data transfer (initial position)

1 = CONTINUOUS: Continuous position data transfer mode

91.31 ENDAT MAX CALC

Selects the maximum encoder calculation time for EnDat encoder.

Note: This parameter needs to be set only when an EnDat encoder is used in continuous mode, i.e. EnDat encoder without incremental sin/cos signals (supported only as encoder 1). EnDat encoder is selected by setting parameter *91.02* ABS ENC INTERF to ENDAT.

0 = 10 µs

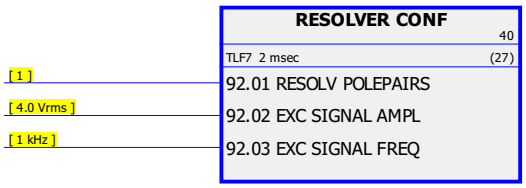
1 = 100 µs

2 = 1 ms

3 = 50 ms

RESOLVER CONF

(40)



Description

With the RESOLVER CONF the user can configure the resolver connection.

The optional FEN-21 Resolver Interface module is compatible with resolvers, which are excited by sinusoidal voltage (to the rotor winding), and which generate sine and cosine signals proportional to the rotor angle (to stator windings).

For more information, see *Resolver Interface Module FEN-21 User's Manual* [3AFE68784859 (English)].

Inputs

Used when parameter *90.01*/*90.02* ENCODER 1/2 SEL setting is FEN-21 RES.

Note: Configuration data is written into the logic registers of the adapter once after the power-up. If parameter values are changed, save values into the permanent memory by parameter *16.07* PARAM SAVE. The new settings will take effect when the drive is powered up again, or after re-configuration is forced by parameter 90.10 ENC PAR REFRESH.

Resolver autotuning is performed automatically whenever the resolver input is activated after changes to parameters 92.02 EXC SIGNAL AMPL or 92.03 EXC SIGNAL FREQ. Autotuning must be forced after any changes in the resolver cable connection. This can be done by setting either parameter 92.02 EXC SIGNAL AMPL or parameter 92.03 EXC SIGNAL FREQ to its already existing value, and then setting parameter 90.10 ENC PAR REFRESH to 1.

If the resolver (or absolute encoder) is used for feedback from a permanent magnet motor, an AUTOPHASING ID run (see parameter 99.13 IDRUN MODE) should be performed after replacement or any parameter changes as well. The ID run detects the difference between the actual pole axis angle and the 0° position indicated by the resolver.

92.01 RESOLV POLEPAIRS

Selects the number of pole pairs.
Range: 1…32

92.02 EXC SIGNAL AMPL

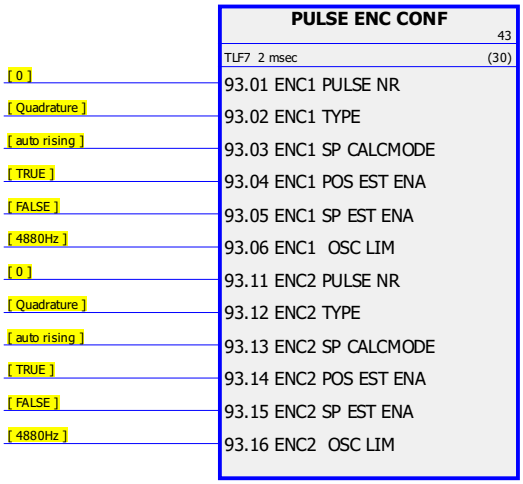
Defines the amplitude of the excitation signal.
Range: 4…12 Vrms (in steps of 0.1 Vrms)

92.03 EXC SIGNAL FREQ

Defines the frequency of the excitation signal.
Range: 1…20 kHz (in steps of 1 kHz)

PULSE ENC CONF

(43)



Description

With the PULSE ENC CONF block the user can configure the TTL encoder connection. TTL interface is offered by the optional FEN-01, FEN-11 and FEN-21 Interface modules.

FEN-01 TTL Encoder interface module has two TTL inputs: TTL+ and TTL. The TTL+ input supports commutation signals. The FEN-01 is compatible with the following TTL encoders:

- TTL incremental encoder with or without zero pulse, with or without commutation signals

FEN-11 Absolute Encoder Interface module has one TTL input. FEN-11 is compatible with the following TTL encoders:

- TTL incremental encoder with or without zero pulse

FEN-21 Resolver Interface module has one TTL input. FEN-21 is compatible with the following TTL encoders:

- TTL incremental encoders with or without zero pulse

For more information, see *TTL Encoder Interface Module FEN-01 User's Manual* [3AFE68784603 (English)], *Resolver Interface Module FEN-21 User's Manual* [3AFE68784859 (English)] or *Absolute Encoder Interface FEN-11 User's Manual* [3AFE68784841 (English)].

Inputs

Parameters *93.01*…*93.06* are used when TTL encoder is used as encoder 1 (i.e. when parameter *90.01* ENCODER 1 SEL setting is FEN-01 TTL+, FEN-01 TTL, FEN-11 TTL or FEN-21 TTL).

Parameters *93.11*…*93.16* are used when TTL encoder is used as encoder 2 (i.e. when parameter *90.02* ENCODER 2 SEL setting is FEN-01 TTL+, FEN-01 TTL, FEN-11 TTL or FEN-21 TTL).

In normal operation, only parameter *93.01*/*93.11* needs to be set for TTL encoders.

Note: Configuration data is written into the logic registers of the adapter once after the power-up. If parameter values are changed, save values into the permanent memory by parameter *16.07* PARAM SAVE. The new settings will take effect when the drive is powered up again, or after re-configuration is forced by parameter 90.10 ENC PAR REFRESH.

93.01 ENC1 PULSE NR

Defines the pulse number per revolution for encoder 1.

Range: 0…65535

93.02 ENC1 TYPE

Selects the type of the encoder 1.

0 = QUADRATURE: Quadrature encoder (has two TTL channels, channels A and B)

1 = SINGLE TRACK: Single track encoder (has one TTL channel, channel A)

93.03 ENC1 SP CALCMODE

Selects the speed calculation mode for encoder 1.

0 = A&B ALL: Channels A and B: Rising and falling edges are used for speed calculation. Channel B: Defines the direction of rotation. (*

Note: When single track mode has been selected by parameter *93.02* ENC1 TYPE, setting 0 acts like setting 1.

1 = A ALL: Channel A: Rising and falling edges are used for speed calculation. Channel B: Defines the direction of rotation. (*

2 = A RISING: Channel A: Rising edges are used for speed calculation. Channel B: Defines the direction of rotation. (*

3 = A FALLING: Channel A: Falling edges are used for speed calculation. Channel B: Defines the direction of rotation. (*

4 = AUTO RISING or 5 = AUTO FALLING: Used mode (1, 2 or 3) is changed automatically depending on the TTL pulse frequency according to the following table:

99.03 = 4	**99.03 = 5**	**Pulse frequency of the channel(s)**
Used mode		
0	0	< 2442 Hz
1	1	2442…4884 Hz
2	3	> 4884 Hz

(* **Note:** When single track mode has been selected by parameter *93.02* ENC1 TYPE, the speed is always positive.

93.04 ENC1 POS EST ENA

Selects whether measured and estimated position is used with encoder 1.

0 = FALSE: Measured position (Resolution: 4 x pulses per revolution for quadrature encoders, 2 x pulses per revolution for single track encoders.)

1 = TRUE: Estimated position (Uses position extrapolation. Extrapolated at the time of data request.)

93.05 ENC1 SP EST ENA

Selects whether calculated or estimated speed is used with encoder 1.

0 = FALSE: Last calculated speed (calculation interval is 62.5 µs…4 ms)

1 = TRUE: Estimated speed (estimated at the time of data request) Estimation increases the speed ripple in steady state operation, but improves the dynamics.

93.06 ENC1 OSC LIM

Selects the maximum pulse frequency for the changing of the direction of rotation (used with encoder 1). Pulses that occur at pulse frequencies above the selected value, are ignored.

0 = 4880 Hz

1 = 2440 Hz

2 = 1220 Hz

3 = DISABLED

93.11 ENC2 PULSE NR

Defines the pulse number per revolution for encoder 2.

Range: 0…65535

93.12 ENC2 TYPE

Selects the type of the encoder 2.

For selections, see parameter *93.02* ENC1 TYPE

93.13 ENC2 SP CALCMODE

Selects the speed calculation mode for encoder 2.

For selections, see parameter *93.03* ENC1 SP CALC MODE.

93.14 ENC2 POS EST ENA

Selects whether measured and estimated position is used with encoder 2.

For selections, see parameter *93.04* ENC1 POS EST ENA.

93.15 ENC2 SP EST ENA

Selects whether calculated or estimated speed is used with encoder 2.

For selections, see parameter *93.05* ENC1 SP EST ENA.

93.16 ENC2 OSC LIM

Selects the maximum pulse frequency for the changing of the direction of rotation (used with encoder 2).

For selections, see parameter *93.06* ENC1 OSC LIM.

HW CONFIGURATION

Note: The HW CONFIGURATION parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

The HW CONFIGURATION parameters include miscellaneous hardware-related settings.

Parameters

95.01 CTRL UNIT SUPPLY

0 = INTERNAL 24V: The drive control unit is powered from the drive power unit it is mounted on (default)

1 = EXTERNAL 24V: The drive control unit is powered from an external power supply.

95.02 EXTERNAL CHOKE

Defines if the drive is equipped with an AC choke or not.

0 = NO: The drive is not equipped with an AC choke.

1 = YES: The drive is equipped with an AC choke.

USER MOTOR PAR

Note: The USER MOTOR PAR parameters do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

With the USER MOTOR PAR parameters the user can change the motor model values estimated during the ID run.

Most of the values can be input as either “per unit” or SI values.

Parameters

97.01 USE GIVEN PARAMS

Activates the motor model parameters 97.02…97.14.

Note: This parameter cannot be changed while the drive is running.

0 = NO: Inactive

1 = USE GIVEN: The values of parameters 97.02…97.14 or parameters are used in the motor model.

Parameter value is automatically set to zero when ID run is selected by parameter 99.13 IDRUN MODE. The values of parameters 97.02…97.14 values are updated according to the motor characteristics identified during the ID run.

97.02 RS USER

Defines the stator resistance R_S of the motor model.

Range: 0…0.5 p.u. (per unit).

97.03 RR USER

Defines the rotor resistance R_R of the motor model.

Note: This parameter is valid only for asynchronous motors.

Range: 0…0.5 p.u. (per unit).

97.04 LM USER

Defines the main inductance L_M of the motor model.

Note: This parameter is valid only for asynchronous motors.

Range: 0…10 p.u. (per unit).

97.05 SIGMAL USER

Defines the leakage inductance σL_S.

Note: This parameter is valid only for asynchronous motors.

Range: 0…1 p.u. (per unit).

97.06 LD USER

Defines the direct axis (synchronous) inductance.

Note: This parameter is valid only for permanent magnet motors.

Range: 0…10 p.u. (per unit).

97.07 LQ USER

Defines the quadrature axis (synchronous) inductance.
Note: This parameter is valid only for permanent magnet motors.
Range: 0…10 p.u. (per unit).

97.08 PM FLUX USER

Defines the permanent magnet flux.
Note: This parameter is valid only for permanent magnet motors.
Range: 0…2 p.u. (per unit).

97.09 RS USER SI

Defines the stator resistance R_S of the motor model.
Range: 0.00000…100.00000 ohm.

97.10 RR USER SI

Defines the rotor resistance R_R of the motor model.
Note: This parameter is valid only for asynchronous motors.
Range: 0.00000…100.00000 ohm.

97.11 LM USER SI

Defines the main inductance L_M of the motor model.
Note: This parameter is valid only for asynchronous motors.
Range: 0.00…100000.00 mH.

97.12 SIGL USER SI

Defines the leakage inductance σL_S.
Note: This parameter is valid only for asynchronous motors.
Range: 0.00…100000.00 mH.

97.13 LD USER SI

Defines the direct axis (synchronous) inductance.
Note: This parameter is valid only for permanent magnet motors.
Range: 0.00…100000.00 mH.

97.14 LQ USER SI

Defines the quadrature axis (synchronous) inductance.
Note: This parameter is valid only for permanent magnet motors.
Range: 0.00…100000.00 mH.

MOTOR CALC VALUES

Note: The MOTOR CALC VALUES do not belong to any firmware block, i.e. they can only be accessed via the optional control panel or the PC tool Parameter Browser.

Description

The MOTOR CALC VALUES shows calculated motor values.

Parameters

98.01 TORQ NOM SCALE

Nominal torque in Nm which corresponds to 100%.
Note: This parameter is copied from parameter 99.12 if given. Otherwise the value is calculated.
Range: 0…2147483 Nm

98.02 POLEPAIRS

Calculated number of motor pole pairs.
Note: This parameter cannot be set by the user.
Range: 0…1000

Parameter and signal data

What this chapter contains

This chapter lists the actual signals and parameters with some additional data. For the signal and parameter descriptions, see chapter Firmware functions, parameters and signals.

Terms

Term	Definition
Actual signal	Signal measured or calculated by the drive. Can be monitored by the user. No user setting is possible.
Def	Default value
enum	Enumerated list, i.e. selection list
FbEq	Fieldbus equivalent: The scaling between the value shown on the panel and the integer used in serial communication.
Page no.	Page number for more information
INT32	32-bit integer value (31 bits + sign)
Bit pointer	Bit pointer. A bit pointer points to the bit value of another signal.
Val pointer	Value pointer. A value pointer points to the value of another parameter/ signal.
Parameter	A user-adjustable operation instruction of the drive
Pb	Packed boolean
PT	Parameter protection type. See WP and WPD.
REAL	16-bit value 16-bit value (31 bits + sign) = integer value = fractional value
REAL24	8-bit value 24-bit value (31 bits + sign) = integer value = fractional value
Type	Data type. See enum, INT32, Bit pointer, Val pointer, Pb, REAL, REAL24, UINT32.
UINT32	32-bit unsigned integer value
WP	Write protected parameter (i.e. read only)
WPD	Write protected parameter while drive is running

Fieldbus equivalent

Serial communication data between fieldbus adapter and drive is transferred in integer format. Thus the drive actual and reference signal values must be scaled to 16/32-bit integer values. Fieldbus equivalent defines the scaling between the signal value and the integer used in serial communication.

All the read and sent values are limited to 16/32 bits.

Example: If 32.04 MAXIMUM TORQ REF is set from external control system, an integer value of 10 corresponds to 1%.

Fieldbus addresses

For FPBA-01 Profibus Adapter, FDNA-01 DeviceNet Adapter and FCAN-01 CANopen Adapter, see the User's Manual of the fieldbus adapter module.

Pointer parameter format in fieldbus communication

Value and bit pointer parameters are transferred between the fieldbus adapter and drive as 32-bit integer values.

32-bit integer value pointers

When value pointer parameter is connected to the value of another parameter or signal, the format is as follows:

	Bit			
	30…31	**16…29**	**8…15**	**0…7**
Name	Source type		Group	Index
Value	1	-	1…255	1…255
Description	Value pointer is connected to parameter/signal.	-	Group of source parameter	Index of source parameter

When value pointer parameter is connected to a solution program, the format is as follows:

	Bit		
	30…31	**24…29**	**0…23**
Name	Source type	Not in use	Address
Value	2	-	$0…2^{23}$
Description	Value pointer is connected to solution program.	-	Relative address of solution program variable

Note: Value pointer parameters, which are connected to a solution program, cannot be set via fieldbus (i.e. read access only).

32-bit integer bit pointers

When bit pointer parameter is connected to value 0 or 1, the format is as follows:

	Bit		
	30…31	**16…29**	**0**
Name	Source type	Not in use	Value
Value	0	-	0…1
Description	Bit pointer is connected to 0/1.	-	0 = False, 1 = True

When bit pointer is connected to a bit value of another signal, the format is as follows:

	Bit				
	30…31	**24…29**	**16…23**	**8…15**	**0…7**
Name	Source type	Not in use	Bit sel	Group	Index
Value	1	-	0…31	2…255	1…255
Description	Bit pointer is connected to signal bit value.	-	Bit selection	Group of source parameter	Index of source parameter

When bit pointer parameter is connected to a solution program, the format is as follows:

	Bit		
	30…31	**24…29**	**0…23**
Name	Source type	Bit sel	Address
Value	2	0…31	$0…2^{23}$
Description	Bit pointer is connected to solution program.	Bit selection	Relative address of solution program variable

Note: Bit pointer parameters which are connected to a solution program, cannot be set via fieldbus (i.e. read access only).

Actual signals

Index	Name	Type	Range	Unit	FbEq	Update time	Page no.	Data length	PT	
01	ACTUAL VALUES									
1.01	SPEED ACT	REAL	-30000…30000	rpm	1 = 100	250 µs	90	32	WP	
1.02	SPEED ACT PERC	REAL	-1000…1000	%	1 = 100	2 ms	41	32	WP	
1.03	FREQUENCY	REAL	-30000…30000	Hz	1 = 100	2 ms	41	32	WP	
1.04	CURRENT	REAL	0…30000	A	1 = 100	10 ms	41	32	WP	
1.05	CURRENT PERC	REAL	0…1000	%	1 = 10	2 ms	41	16	WP	
1.06	TORQUE	REAL	-1600…1600	%	1 = 10	2 ms	41	16	WP	
1.07	DC-VOLTAGE	REAL	-	V	1 = 100	2 ms	41	32	WP	
1.08	ENCODER 1 SPEED	REAL	-	rpm	1 = 100	250 µs	167	32	WP	
1.09	ENCODER 1 POS	REAL24	-	rev	1=100000000	250 µs	167	32	WP	
1.10	ENCODER 2 SPEED	REAL	-	rpm	1 = 100	250 µs	167	32	WP	
1.11	ENCODER 2 POS	REAL24	-	rev	1=100000000	250 µs	168	32	WP	
1.14	SPEED ESTIMATED	REAL	-30000…30000	rpm	1 = 100	2 ms	41	32	WP	
1.15	TEMP INVERTER	REAL24	-40…160	°C	1 = 100	2 ms	41	16	WP	
1.16	TEMP BC	REAL24	-40…160	°C	1 = 1	2 ms	42	16	WP	
1.17	MOTOR TEMP	REAL	-10…250	°C	1 = 10	10 ms	131	16	WP	
1.18	MOTOR TEMP EST	INT32	-60…1000	°C	1 = 1	-	131	16	WP	
1.19	USED SUPPLY VOLT	REAL	0…1000	V	1 = 10	10 ms	139	16	WP	
1.20	BRAKE RES LOAD	REAL24	0…1000	%	1 = 100	50 ms	42	16	WP	
1.21	CPU USAGE	UINT32	0…100	%	1 = 1	-	42	16	WP	
02	I/O									
2.01	DI STATUS	Pb	0…0x3F	-	1 = 1	250 µs	49	16	WP	
2.02	RO STATUS	Pb	-	-	1 = 1	250 µs	54	16	WP	
2.03	DIO STATUS	Pb	-	-	1 = 1	250 µs	50, 51, 53	16	WP	
2.04	AI1	REAL	-	V or mA	1 = 1000	2 ms	57	16	WP	
2.05	AI1 SCALED	REAL	-	-	1 = 1000	250 µs	57	32	WP	
2.06	AI2	REAL	-	V or mA	1 = 1000	2 ms	59	16	WP	
2.07	AI2 SCALED	REAL	-	-	1 = 1000	250 µs	59	32	WP	
2.08	AO1	REAL	-	mA	1 = 1000	2 ms	61	16	WP	
2.09	AO2	REAL	-	V	1 = 1000	2 ms	63	16	WP	
2.10	DIO2 FREQ IN	REAL	0…32767	Hz	1 = 1000	250 µs	51	32	WP	
2.11	DIO3 FREQ OUT	REAL	0…32767	Hz	1 = 1000	250 µs	53	32	WP	
2.12	FBA MAIN CW	Pb	$-2^{31}…2^{32}-1$	-	1 = 1	500 µs	151	32	WP	
2.13	FBA MAIN SW	Pb	$-2^{31}…2^{32}-1$	-	1 = 1	-	154	32	WP	
2.14	FBA MAIN REF1	INT32	$-2^{31}…2^{31}-1$	-	1 = 1	500 µs	155	32	WP	
2.15	FBA MAIN REF2	INT32	$-2^{31}…2^{31}-1$	-	1 = 1	500 µs	155	32	WP	
2.16	FEN DI STATUS	Pb	0…0x33	-	1 = 1	500 µs	168	16	WP	
2.17	D2D MAIN CW	Pb	0…0xFFFF	-	1 = 1	500 µs	162	16	WP	
2.18	D2D FOLLOWER CW	Pb	0…0xFFFF	-	1 = 1	2 ms	69	16	WP	
2.19	D2D REF1	REAL	$-2^{31}…2^{31}-1$	-	1 = 1	500 µs	162	32	WP	
2.20	D2D REF2	REAL	$-2^{31}…2^{31}-1$	-	1 = 1	500 µs	163	32	WP	

Index	Name	Type	Range	Unit	FbEq	Update time	Page no.	Data length	PT	
03	CONTROL VALUES									
3.01	SPEED REF1	REAL	-30000…30000	rpm	1 = 100	250 µs	92	32	WP	
3.02	SPEED REF2	REAL	-30000…30000	rpm	1 = 100	250 µs	92	32	WP	
3.03	SPEEDREF RAMP IN	REAL	-30000…30000	rpm	1 = 100	250 µs	96	32	WP	
3.04	SPEEDREF RAMPED	REAL	-30000…30000	rpm	1 = 100	250 µs	100	32	WP	
3.05	SPEEDREF USED	REAL	-30000…30000	rpm	1 = 100	250 µs	103	32	WP	
3.06	SPEED ERROR FILT	REAL	-30000…30000	rpm	1 = 100	250 µs	103	32	WP	
3.07	ACC COMP TORQ	REAL	-1600…1600	%	1 = 10	250 µs	103	16	WP	
3.08	TORQ REF SP CTRL	REAL	-1600…1600	%	1 = 10	250 µs	108	16	WP	
3.09	TORQ REF1	REAL	-1000…1000	%	1 = 10	250 µs	110	16	WP	
3.10	TORQ REF RAMPED	REAL	-1000…1000	%	1 = 10	250 µs	112	16	WP	
3.11	TORQ REF RUSHLIM	REAL	-1000…1000	%	1 = 10	250 µs	112	16	WP	
3.12	TORQUE REF ADD	REAL	-1000…1000	%	1 = 10	250 µs	110	16	WP	
3.13	TORQ REF TO TC	REAL	-1600…1600	%	1 = 10	250 µs	117	16	WP	
3.14	BRAKE TORQ MEM	REAL	-1000…1000	%	1 = 10	2 ms	123	16	WP	
3.15	BRAKE COMMAND	enum	0…1	-	1 = 1	2 ms	123	16	WP	
3.16	FLUX REF USED	REAL24	0…200	%	1 = 1	2 ms	125	16	WP	
06	DRIVE STATUS									
6.01	STATUS WORD 1	Pb	0…65535	-	1 = 1	2 ms	70	16	WP	
6.02	STATUS WORD 2	Pb	0…65535	-	1 = 1	2 ms	71	16	WP	
6.03	SPEED CTRL STAT	Pb	0…31	-	1 = 1	250 µs	72	16	WP	
6.05	LIMIT WORD 1	Pb	0…255	-	1 = 1	250 µs	72	16	WP	
6.07	TORQ LIM STATUS	Pb	0…65535	-	1 = 1	250 µs	73	16	WP	
6.12	OP MODE ACK	enum	0…11	-	1 = 1	2 ms	117	16	WP	
08	ALARMS & FAULTS									
8.01	ACTIVE FAULT	enum	0…65535	-	1 = 1	-	134	16	WP	
8.02	LAST FAULT	enum	0…65535	-	1 = 1	-	134	16	WP	
8.03	FAULT TIME HI	INT32	-2^{31}…2^{31} - 1	days	1 = 1	-	134	32	WP	
8.04	FAULT TIME LO	INT32	-2^{31}…2^{31} - 1	time	1 = 1	-	134	32	WP	
8.05	ALARM WORD 1	UINT32	-	-	1 = 1	2 ms	134	16	WP	
8.06	ALARM WORD 2	UINT32	-	-	1 = 1	2 ms	135	16	WP	
8.07	ALARM WORD 3	UINT32	-	-	1 = 1	2 ms	135	16	WP	
09	SYSTEM INFO									
9.01	DRIVE TYPE	INT32	0…65535	-	1 = 1	-	43	16	WP	
9.02	DRIVE RATING ID	INT32	0…65535	-	1 = 1	-	43	16	WP	
9.03	FIRMWARE ID	Pb	-	-	1 = 1	-	43	16	WP	
9.04	FIRMWARE VER	Pb	-	-	1 = 1	-	43	16	WP	
9.20	OPTION SLOT 1	INT32	0…18	-	1 = 1	-	43	16	WP	
9.21	OPTION SLOT 2	INT32	0…18	-	1 = 1	-	43	16	WP	
9.22	OPTION SLOT 3	INT32	0…18	-	1 = 1	-	43	16	WP	

Parameters

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
10	START/STOP										
10.01	EXT1 START FUNC	enum	0…4	-	-	2 ms	66	16	1	WPD	
10.02	EXT1 START IN1	Bit pointer		-		2 ms	66	32	P.02.01.00	WPD	
10.03	EXT1 START IN2	Bit pointer		-		2 ms	66	32	C.False	WPD	
10.04	EXT2 START FUNC	enum	0…4	-	-	2 ms	67	16	1	WPD	
10.05	EXT2 START IN1	Bit pointer		-		2 ms	67	32	P.02.01.00	WPD	
10.06	EXT2 START IN2	Bit pointer		-		2 ms	67	32	C.False	WPD	
10.07	JOG1 START	Bit pointer		-		2 ms	67	32	C.False	WPD	
10.08	FAULT RESET SEL	Bit pointer		-		2 ms	67	32	P.02.01.02		
10.09	RUN ENABLE	Bit pointer		-		2 ms	68	32	C.True	WPD	
10.10	EM STOP OFF3	Bit pointer		-		2 ms	68	32	C.True	WPD	
10.11	EM STOP OFF1	Bit pointer		-		2 ms	68	32	C.True	WPD	
10.12	START INHIBIT	enum	0…1	-	1 = 1	2 ms	68	16	0		
10.13	FB CW USED	Val pointer		-		2 ms	68	32	P.02.12	WPD	
10.14	JOG2 START	Bit pointer		-		2 ms	68	32	C.False	WPD	
10.15	JOG ENABLE	Bit pointer		-		2 ms	69	32	C.False	WPD	
11	START/STOP MODE										
11.01	START MODE	enum	0…2	-	1 = 1	-	78	16	1	WPD	
11.02	DC MAGN TIME	UINT32	0…10000	ms	1 = 1	-	78	16	500	WPD	
11.03	STOP MODE	enum	1…2	-	1 = 1	2 ms	79	16	2		
11.04	DC HOLD SPEED	REAL	0…1000	rpm	1 = 10	2 ms	79	16	5		
11.05	DC HOLD CUR REF	UINT32	0…100	%	1 = 1	2 ms	79	16	30		
11.06	DC HOLD	enum	0…1	-	1 = 1	2 ms	79	16	0		
11.07	AUTOPHASING MODE	enum	0…2	-	1 = 1	-	79	16	1		
12	DIGITAL IO										
12.01	DIO1 CONF	enum	0…1	-	1 = 1	10 ms	50	16	0		
12.02	DIO2 CONF	enum	0…2	-	1 = 1	10 ms	51	16	0		
12.03	DIO3 CONF	enum	0…3	-	1 = 1	10 ms	52	16	0		
12.04	DIO1 OUT PTR	Bit pointer		-		10 ms	50	32	P.06.02.02		
12.05	DIO2 OUT PTR	Bit pointer		-		10 ms	51	32	P.06.02.03		
12.06	DIO3 OUT PTR	Bit pointer		-		10 ms	52	32	P.06.01.10		
12.07	DIO3 F OUT PTR	Val pointer		-		10 ms	52	32	P.01.01		
12.08	DIO3 F MAX	REAL	3…32768	Hz	1 = 1	10 ms	52	16	1000		
12.09	DIO3 F MIN	REAL	3…32768	Hz	1 = 1	10 ms	52	16	3		
12.10	DIO3 F MAX SCALE	REAL	0…32768	-	1 = 1	10 ms	53	16	1500		
12.11	DIO3 F MIN SCALE	REAL	0…32768	-	1 = 1	10 ms	53	16	0		
12.12	RO1 OUT PTR	Bit pointer		-		10 ms	54	32	P.03.15.00		
12.13	DI INVERT MASK	UINT32	0…63	-	1 = 1	10 ms	49	16	0		
13	ANALOGUE INPUTS										
13.01	AI1 FILT TIME	REAL	0…30	s	1 = 1000	10 ms	55	16	0		
13.02	AI1 MAX	REAL	-11…11/ -22…22	V or mA	1 = 1000	10 ms	55	16	10		

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
13.03	AI1 MIN	REAL	-11…11/ -22…22	V or mA	1 = 1000	10 ms	56	16	-10		
13.04	AI1 MAX SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	56	32	1500		
13.05	AI1 MIN SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	56	32	-1500		
13.06	AI2 FILT TIME	REAL	0…30	s	1 = 1000	10 ms	58	16	0		
13.07	AI2 MAX	REAL	-11…11/ -22…22	V or mA	1 = 1000	10 ms	58	16	10		
13.08	AI2 MIN	REAL	-11…11/ -22…22	V or mA	1 = 1000	10 ms	58	16	-10		
13.09	AI2 MAX SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	59	32	100		
13.10	AI2 MIN SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	59	32	-100		
13.11	AITUNE	enum	0…4	-	1 = 1	10 ms	56	16	0		
13.12	AI SUPERVISION	enum	0…3	-	1 = 1	2 ms	57	16	0		
13.13	AI SUPERVIS ACT	UINT32	0000… 1111	-	1 = 1	2 ms	57	32	0		
15	ANALOGUE OUTPUTS										
15.01	AO1 PTR	Val pointer		-		-	60	32	P.01.05		
15.02	AO1 FILT TIME	REAL	0…30	s	1 = 1000	10 ms	60	16	0.1		
15.03	AO1 MAX	REAL	0…22.7	mA	1 = 1000	10 ms	61	16	20		
15.04	AO1 MIN	REAL	0…22.7	mA	1 = 1000	10 ms	61	16	4		
15.05	AO1 MAX SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	61	32	100		
15.06	AO1 MIN SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	61	32	0		
15.07	AO2 PTR	Val pointer		-		-	62	32	P.01.02		
15.08	AO2 FILT TIME	REAL	0…30	s	1 = 1000	10 ms	62	16	0.1		
15.09	AO2 MAX	REAL	-10…10	V	1 = 1000	10 ms	62	16	10		
15.10	AO2 MIN	REAL	-10…10	V	1 = 1000	10 ms	62	16	-10		
15.11	AO2 MAX SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	63	32	100		
15.12	AO2 MIN SCALE	REAL	-32768… 32767	-	1 = 1000	10 ms	63	32	-100		
16	SYSTEM										
16.01	LOCAL LOCK	Bit pointer		-		2 ms	80	32	C.False		
16.02	PARAMETER LOCK	enum	0…2	-	1 = 1	2 ms	80	16	1		
16.03	PASS CODE	INT32	$0…2^{31}$ -1	-	1 = 1	-	80	32	0		
16.04	PARAM RESTORE	enum	0…2	-	1 = 1	-	80	16	0	WPD	
16.07	PARAM SAVE	enum	0…1	-	1 = 1	-	81	16	0		
16.09	USER SET SEL	enum	1…10	-	1 = 1	-	81	32	1	WPD	
16.10	USER SET LOG	Pb	0…0x7FF	-	1 = 1	-	81	32	0	WP	
16.11	USER IO SET LO	Bit pointer		-		-	81	32	C.False		
16.12	USER IO SET HI	Bit pointer		-		-	81	32	C.False		

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
17	PANEL DISPLAY										
17.01	SIGNAL1 PARAM	INT32	00.00… 255.255	-	1 = 1		82	16	01.03		
17.02	SIGNAL2 PARAM	INT32	00.00… 255.255	-	1 = 1		82	16	01.04		
17.03	SIGNAL3 PARAM	INT32	00.00… 255.255	-	1 = 1		82	16	01.06		
20	LIMITS										
20.01	MAXIMUM SPEED	REAL	0…30000	rpm	1 = 1	2 ms	83	32	1500		
20.02	MINIMUM SPEED	REAL	-30000…0	rpm	1 = 1	2 ms	83	32	-1500		
20.03	POS SPEED ENA	Bit pointer		-		2 ms	84	32	C.True		
20.04	NEG SPEED ENA	Bit pointer		-		2 ms	84	32	C.True		
20.05	MAXIMUM CURRENT	REAL	0…30000	A	1 = 100	10 ms	84	32	-		
20.06	MAXIMUM TORQUE	REAL	0…1600	%	1 = 10	2 ms	84	16	300		
20.07	MINIMUM TORQUE	REAL	-1600…0	%	1 = 10	2 ms	84	16	-300		
20.08	THERM CURR LIM	enum	0…1	-	1 = 1	-	85	16	1		
22	SPEED FEEDBACK										
22.01	SPEED FB SEL	enum	0…2	-	1 = 1	10 ms	88	16	0		
22.02	SPEED ACT FTIME	REAL	0…10000	ms	1 = 1000	10 ms	88	32	3		
22.03	MOTOR GEAR MUL	INT32	-2^{31}…2^{31}-1	-	1 = 1	10 ms	88	32	1		
22.04	MOTOR GEAR DIV	UINT32	1…2^{31}-1	-	1 = 1	10 ms	88	32	1		
22.05	ZERO SPEED LIMIT	REAL	0…30000	rpm	1 = 1000	2 ms	88	32	30		
22.06	ZERO SPEED DELAY	UINT32	0…30000	ms	1 = 1	2 ms	89	16	0		
22.07	ABOVE SPEED LIM	REAL	0…30000	rpm	1 = 1	2 ms	89	16	0		
22.08	SPEED TRIPMARGIN	REAL	0…10000	rpm	1 = 10	2 ms	89	32	500		
24	SPEED REF MOD										
24.01	SPEED REF1 SEL	enum	0…8	-	1 = 1	10 ms	92	16	1		
24.02	SPEED REF2 SEL	enum	0…8	-	1 = 1	10 ms	92	16	0		
24.03	SPEED REF1 IN	Val pointer		-		10 ms	94	32	P.03.01		
24.04	SPEED REF2 IN	Val pointer		-		10 ms	94	32	P.03.02		
24.05	SPEED REF 1/2SEL	Bit pointer		-		2 ms	94	32	C.False		
24.06	SPEED SHARE	REAL	-8…8	-	1 = 1000	2 ms	95	16	1		
24.07	SPEEDREF NEG ENA	Bit pointer		-		2 ms	95	32	C.False		
24.08	CONST SPEED	REAL	-30000…. 30000	rpm	1 = 1	2 ms	95	16	0		
24.09	CONST SPEED ENA	Bit pointer		-		2 ms	95	32	C.False		
24.10	SPEED REF JOG1	REAL	-30000…. 30000	rpm	1 = 1	2 ms	95	16	0		
24.11	SPEED REF JOG2	REAL	-30000…. 30000	rpm	1 = 1	2 ms	95	16	0		
24.12	SPEED REFMIN ABS	REAL	0…30000	rpm	1 = 1	2 ms	95	16	0		
25	SPEED REF RAMP										
25.01	SPEED RAMP IN	Val pointer		-		10 ms	98	32	P.03.03	WP	
25.02	SPEED SCALING	REAL	0…30000	rpm	1 = 1	10 ms	98	16	1500		
25.03	ACC TIME	REAL	0…1800	s	1 = 1000	10 ms	98	32	1		

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
25.04	DEC TIME	REAL	0…1800	s	1 = 1000	10 ms	99	32	1		
25.05	SHAPE TIME ACC1	REAL	0…1000	s	1 = 1000	10 ms	99	32	0		
25.06	SHAPE TIME ACC2	REAL	0…1000	s	1 = 1000	10 ms	99	32	0		
25.07	SHAPE TIME DEC1	REAL	0…1000	s	1 = 1000	10 ms	99	32	0		
25.08	SHAPE TIME DEC2	REAL	0…1000	s	1 = 1000	10 ms	99	32	0		
25.09	ACC TIME JOGGING	REAL	0…1800	s	1 = 1000	10 ms	100	32	0		
25.10	DEC TIME JOGGING	REAL	0…1800	s	1 = 1000	10 ms	100	32	0		
25.11	EM STOP TIME	REAL	0…1800	s	1 = 1000	10 ms	100	32	1		
25.12	SPEEDREF BAL	REAL	-30000… 30000	rpm	1 = 1000	2 ms	100	32	0		
25.13	SPEEDREF BAL ENA	Bit pointer		-		2 ms	100	32	C.False		
26	SPEED ERROR										
26.01	SPEED ACT NCTRL	Val pointer		-		2 ms	102	32	P.01.01	WP	
26.02	SPEED REF NCTRL	Val pointer		-		2 ms	102	32	P.03.04	WP	
26.03	SPEED REF PCTRL	Val pointer		-		2 ms	102	32	P.04.01		
26.04	SPEED FEED PCTRL	Val pointer		-		2 ms	102	32	P.04.20		
26.05	SPEED STEP	REAL	-30000… 30000	rpm	1 = 100	2 ms	102	32	0		
26.06	SPD ERR FTIME	REAL	0…1000	ms	1 = 10	2 ms	102	16	0		
26.07	SPEED WINDOW	REAL	0…30000	rpm	1 = 1	250 µs	103	16	100		
26.08	ACC COMP DERTIME	REAL	0…600	s	1 = 100	2 ms	103	32	0		
26.09	ACC COMP FTIME	REAL	0…1000	ms	1 = 10	2 ms	103	16	8		
28	SPEED CONTROL										
28.01	SPEED ERR NCTRL	Val pointer		-		2 ms	105	32	P.03.06	WP	
28.02	PROPORT GAIN	REAL	0…200	-	1 = 100	2 ms	105	16	10		
28.03	INTEGRATION TIME	REAL	0…600	s	1 = 100	2 ms	106	32	0.5		
28.04	DERIVATION TIME	REAL	0…10	s	1 = 1000	2 ms	106	16	0		
28.05	DERIV FILT TIME	REAL	0…1000	ms	1 = 10	2 ms	107	16	8		
28.06	ACC COMPENSATION	Val pointer		-		2 ms	107	32	P.03.07	WP	
28.07	DROOPING RATE	REAL	0…100	%	1 = 100	2 ms	107	16	0		
28.08	BAL REFERENCE	REAL	-1600… 1600	%	1 = 10	2 ms	107	16	0		
28.09	SPEEDCTRL BAL EN	Bit pointer		-		2 ms	107	32	C.False		
28.10	MIN TORQ SP CTRL	REAL	-1600… 1600	%	1 = 10	2 ms	108	16	-300		
28.11	MAX TORQ SP CTRL	REAL	-1600… 1600	%	1 = 10	2 ms	108	16	300		
32	TORQUE REFERENCE										
32.01	TORQ REF1 SEL	enum	0…4	-	1 = 1	10 ms	109	16	2		
32.02	TORQ REF ADD SEL	enum	0…4	-	1 = 1	10 ms	110	16	0		
32.03	TORQ REF IN	Val pointer		-		250 µs	112	32	P.03.09		
32.04	MAXIMUM TORQ REF	REAL	0…1000	%	1 = 10	250 µs	112	16	300		

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
32.05	MINIMUM TORQ REF	REAL	-1000…0	%	1 = 10	250 µs	112	16	-300		
32.06	LOAD SHARE	REAL	-8…8	-	1 = 1000	250 µs	112	16	1		
32.07	TORQ RAMP UP	UINT32	0…60	s	1 = 1000	10 ms	112	32	0		
32.08	TORQ RAMP DOWN	UINT32	0…60	s	1 = 1000	10 ms	112	32	0		
34	REFERENCE CTRL										
34.01	EXT1/EXT2 SEL	Bit pointer		-		2 ms	115	32	P.02.01.01		
34.02	EXT1 MODE 1/2SEL	Bit pointer		-		2 ms	115	32	C.False (P.02.01.05 for pos. appl.)		
34.03	EXT1 CTRL MODE1	enum	1…5 (1…9 for pos. appl.)	-	1 = 1	2 ms	116	16	1		
34.04	EXT1 CTRL MODE2	enum	1…5 (1…9 for pos. appl.)	-	1 = 1	2 ms	116	16	2 (8 for pos. appl.)		
34.05	EXT2 CTRL MODE1	enum	1…5 (1…9 for pos. appl.)	-	1 = 1	2 ms	116	16	2 (6 for pos. appl.)		
34.07	LOCAL CTRL MODE	enum	1…2 (1…6 for pos. appl.)	-	1 = 1	2 ms	117	16	1	WPD	
34.08	TREF SPEED SRC	Val pointer		-		250 µs	117	32	P.03.08	WP	
34.09	TREF TORQ SRC	Val pointer		-		250 µs	117	32	P.03.11	WP	
34.10	TORQ REF ADD SRC	Val pointer		-		250 µs	117	32	P.03.12	WP	
35	MECH BRAKE CTRL										
35.01	BRAKE CONTROL	enum	0…2	-	1 = 1	2 ms	121	16	0	WPD	
35.02	BRAKE ACKNOWL	Bit pointer		-		2 ms	122	32	C.False	WPD	
35.03	BRAKE OPEN DELAY	UINT32	0…5	s	1 = 100	2 ms	122	16	0		
35.04	BRAKE CLOSE DLY	UINT32	0…60	s	1 = 100	2 ms	122	16	0		
35.05	BRAKE CLOSE SPD	REAL	0…1000	rpm	1 = 10	2 ms	122	16	100		
35.06	BRAKE OPEN TORQ	REAL	0…1000	%	1 = 10	2 ms	122	16	0		
35.07	BRAKE CLOSE REQ	Bit pointer		-		2 ms	122	32	C.False	WPD	
35.08	BRAKE OPEN HOLD	Bit pointer		-		2 ms	123	32	C.False	WPD	
35.09	BRAKE FAULT FUNC	enum	0…2	-	1 = 1	2 ms	123	16	0		
40	MOTOR CONTROL										
40.01	FLUX REF	REAL	0…200	%	1 = 1	10 ms	124	16	100		
40.02	SF REF	enum	0…16	kHz	1 = 1	-	124	16	4		
40.03	SLIP GAIN	REAL	0…200	%	1 = 1	-	125		100		
40.04	VOLTAGE RESERVE	REAL		V/%	1 = 1	-	125		-		
40.05	FLUX OPTIMIZATION	enum	0…1	-	1 = 1	-	125		-		
40.06	FORCE OPEN LOOP	enum	0…1	-	1 = 1	250 µs	125	16	0		
45	MOT THERM PROT										
45.01	MOT TEMP PROT	enum	0…2	-	1 = 1	10 ms	128	16	0		
45.02	MOT TEMP SOURCE	enum	0…6	-	1 = 1	10 ms	129	16	0		
45.03	MOT TEMP ALM LIM	INT32	0…200	°C	1 = 1	-	129	16	90		

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
45.04	MOT TEMP FLT LIM	INT32	0…200	°C	1 = 1	-	129	16	110		
45.05	AMBIENT TEMP	INT32	-60…100	°C	1 = 1	-	130	16	20		
45.06	MOT LOAD CURVE	INT32	50…150	%	1 = 1	-	130	16	100		
45.07	ZERO SPEED LOAD	INT32	50…150	%	1 = 1	-	130	16	100		
45.08	BREAK POINT	INT32	0.01…500	Hz	1 = 100	-	130	16	45		
45.09	MOTNOMTEMPRISE	INT32	0…300	°C	1 = 1	-	131	16	80		
45.10	MOT THERM TIME	INT32	100…10000	s	1 = 1	-	131	16	256		
46	FAULT FUNCTIONS										
46.01	EXTERNAL FAULT	Bit pointer		-		2 ms	132	32	C.True		
46.02	SPEED REF SAFE	REAL	-30000… 30000	rpm	1 = 1	2 ms	132	16	0		
46.03	LOCAL CTRL LOSS	enum	0…3	-	1 = 1	-	133	16	1		
46.04	MOT PHASE LOSS	enum	0…1	-	1 = 1	2 ms	133	16	1		
46.05	EARTH FAULT	enum	0…2	-	1 = 1	-	133	16	2		
46.06	SUPPL PHS LOSS	enum	0…1	-	1 = 1	2 ms	133	16	1		
46.07	STO DIAGNOSTIC	enum	1…3	-	1 = 1	10 ms	133	16	1		
46.08	CROSS CONNECTION	enum	0…1	-	1 = 1	-	134	16	1		
47	VOLTAGE CTRL										
47.01	OVERVOLTAGE CTRL	enum	0…1	-	1 = 1	10 ms	138	16	1		
47.02	UNDERVOLT CTRL	enum	0…1	-	1 = 1	10 ms	138	16	1		
47.03	SUPPLVOLTAUTO-ID	enum	0…1	-	1 = 1	10 ms	138	16	1		
47.04	SUPPLY VOLTAGE	REAL	0…1000	V	1 = 10	2 ms	138	16	400		
48	BRAKE CHOPPER										
48.01	BC ENABLE	enum	0…1	-	1 = 1	-	140	16	0		
48.02	BC RUN-TIME ENA	Bit pointer		-		2 ms	140	32	C.True		
48.03	BRTHERMTIMECONST	REAL24	0…10000	s	100 = 1	-	140	32	0		
48.04	BR POWER MAX CNT	REAL24	0…10000	kW	1 = 1000	-	140	32	0		
48.05	R BR	REAL24	0.1…1000	ohm	1 = 1000	-	140	32	-		
48.06	BR TEMP FAULTLIM	REAL24	0…150	%	1 = 1	-	141	16	105		
48.07	BR TEMP ALARMLIM	REAL24	0…150	%	1 = 1	-	141	16	95		
50	FIELDBUS										
50.01	FBA ENABLE	enum	0…1	-	1 = 1	-	149	16	0		
50.02	COMM LOSS FUNC	enum	0…3	-	1 = 1	-	149	16	0		
50.03	COMM LOSS T OUT	UINT32	0.3…6553.5	s	1 = 10	-	149	16	0.3		
50.04	FBA REF1 MODESEL	enum	0…2 (0…4 for pos. appl.)	-	1 = 1	10 ms	149	16	2		
50.05	FBA REF2 MODESEL	enum	0…2 (0…4 for pos. appl.)	-	1 = 1	10 ms	150	16	3		
50.06	FBA ACT1 TR SRC	Val pointer		-		10 ms	150	32	P.01.01		
50.07	FBA ACT2 TR SRC	Val pointer		-		10 ms	150	32	P.01.06		

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
50.08	FBA SW B12 SRC	Bit pointer		-		500 µs	150	32	C.False		
50.09	FBA SW B13 SRC	Bit pointer		-		500 µs	150	32	C.False		
50.10	FBA SW B14 SRC	Bit pointer		-		500 µs	150	32	C.False		
50.11	FBA SW B15 SRC	Bit pointer		-		500 µs	150	32	C.False		
51	FBA SETTINGS										
51.01	FBA TYPE	UINT32	0…65536	-	1 = 1		156	16	0		
51.02	FBA PAR2	UINT32	0…65536	-	1 = 1		156	16	0		
…	…	…	…	…	…			….	…		
51.26	FBA PAR26	UINT32	0…65536	-	1 = 1		156	16	0		
51.27	FBA PAR REFRESH	UINT32	0…1	-	1 = 1		157	16	0	WPD	
51.28	PAR TABLE VER	UINT32	0…65536	-	1 = 1		157	16	0		
51.29	DRIVE TYPE CODE	UINT32	0…65536	-	1 = 1		157	16	0		
51.30	MAPPING FILE VER	UINT32	0…65536	-	1 = 1		157	16	0		
51.31	D2FBA COMM STA	UINT32	0…6	-	1 = 1		157	16	0		
51.32	FBA COMM SW VER	UINT32	0…65536	-	1 = 1		157	16	0		
51.33	FBA APPL SW VER	UINT32	0…65536	-	1 = 1		157	16	0		
52	FBA DATA IN										
52.01	FBA DATA IN1	UINT32	0…9999	-	1 = 1		158	16	0		
…	…	…	…	…	…		-	…	…		
52.12	FBA DATA IN12	UINT32	0…9999	-	1 = 1		158	16	0		
53	FBA DATA OUT										
53.01	FBA DATA OUT1	UINT32	0…9999	-	1 = 1		159	16	0		
…	…	…	…	…	…			…	…		
53.12	FBA DATA OUT12	UINT32	0…9999	-	1 = 1		159	16	0		
57	D2D COMMUNICATION										
57.01	LINK MODE	UINT32	0…2	-	1 = 1	10 ms	161	16	0	WPD	
57.02	COMM LOSS FUNC	UINT32	0…2	-	1 = 1	10 ms	161	16	1		
57.03	NODE ADRESS	UINT32	1…62	-	1 = 1	10 ms	161	16	1	WPD	
57.04	FOLLOWER MASK 1	UINT32	$0…2^{31}$	-	1 = 1	10 ms	161	32	0	WPD	
57.05	FOLLOWER MASK 2	UINT32	$0…2^{31}$	-	1 = 1	10 ms	161	32	0	WPD	
57.06	REF 1 SRC	Val pointer		-		10 ms	161	32	P.03.04		
57.07	REF 2 SRC	Val pointer		-		10 ms	161	32	P.03.13		
57.08	FOLLOWER CW SRC	Val pointer		-		10 ms	162	32	P.02.18		
57.09	KERNEL SYNC MODE	enum	0…3	-	1 = 1	10 ms	162	16	0	WPD	
57.10	KERNEL SYNC OFFS	REAL	-4999… 5000	ms	1 = 1	10 ms	162	16	0	WPD	
90	ENC MODULE SEL										
90.01	ENCODER 1 SEL	enum	0…6	-	1 = 1		165	16	0		
90.02	ENCODER 2 SEL	enum	0…6	-	1 = 1		165	16	0		
90.03	EMUL MODE SEL	enum	0…9	-	1 = 1		166	16	0		
90.04	TTL ECHO SEL	enum	0…4	-	1 = 1		166	16	0		
90.05	ENC CABLE FAULT	UINT32	0…2	-	1 = 1		167	16	1		
90.10	ENC PAR REFRESH	UINT32	0…1	-	1 = 1		167	16	0	WPD	

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
91	ABSOL ENC CONF										
91.01	SINE COSINE NR	UINT32	0…65535	-	1 = 1		170	16	0		
91.02	ABS ENC INTERF	UINT32	0…4	-	1 = 1		170	16	0		
91.03	REV COUNT BITS	UINT32	0…32	-	1 = 1		170	16	0		
91.04	POS DATA BITS	UINT32	0…32	-	1 = 1		170	16	0		
91.05	REFMARK ENA	UINT32	0…1	-	1 = 1		170	16	0		
91.10	HIPERFACE PARITY	UINT32	0…1	-	1 = 1		170	16	0		
91.11	HIPERF BAUDRATE	UINT32	0…3	-	1 = 1		171	16	1		
91.12	HIPERF NODE ADDR	UINT32	0…255	-	1 = 1		171	16	64		
91.20	SSI CLOCK CYCLES	UINT32	2…127	-	1 = 1		171	16	2		
91.21	SSI POSITION MSB	UINT32	1…126	-	1 = 1		171	16	1		
91.22	SSI REVOL MSB	UINT32	1…126	-	1 = 1		171	16	1		
91.23	SSI DATA FORMAT	UINT32	0…1	-	1 = 1		171	16	0		
91.24	SSI BAUD RATE	UINT32	0…5	-	1 = 1		171	16	2		
91.25	SSI MODE	UINT32	0…1	-	1 = 1		172	16	0		
91.26	SSI TRANSMIT CYC	UINT32	0…5	-	1 = 1		172	16	1		
91.27	SSI ZERO PHASE	UINT32	0…3	-	1 = 1		172	16	0		
91.30	ENDAT MODE	UINT32	0…1	-	1 = 1		172	16	0		
91.31	ENDAT MAX CALC	UINT32	0…3	-	1 = 1		173	16	3		
92	RESOLVER CONF										
92.01	RESOLV POLEPAIRS	UINT32	1…32	-	1 = 1		174	16	1		
92.02	EXC SIGNAL AMPL	UINT32	4…12	Vrms	1 = 10		174	16	4		
92.03	EXC SIGNAL FREQ	UINT32	1…20	kHz	1 = 1		175	16	1		
93	PULSE ENC CONF										
93.01	ENC1 PULSE NR	UINT32	0…65535	-	1 = 1		177	16	0		
93.02	ENC1 TYPE	enum	0…1	-	1 = 1		177	16	0		
93.03	ENC1 SP CALCMODE	enum	0….5	-	1 = 1		177	16	4		
93.04	ENC1 POS EST ENA	enum	0…1	-	1 = 1		178	16	1		
93.05	ENC1 SP EST ENA	enum	0…1	-	1 = 1		178	16	0		
93.06	ENC1 OSC LIM	enum	0…3	-	1 = 1		178	16	0		
93.11	ENC2 PULSE NR	UINT32	0…65535	-	1 = 1		178	16	0		
93.12	ENC2 TYPE	enum	0…1	-	1 = 1		178	16	0		
93.13	ENC2 SP CALCMODE	enum	0….5	-	1 = 1		178	16	4		
93.14	ENC2 POS EST ENA	enum	0…1	-	1 = 1		178	16	1		
93.15	ENC2 SP EST ENA	enum	0…1	-	1 = 1		178	16	0		
93.16	ENC2 OSC LIM	enum	0…3	-	1 = 1		178	16	0		
93.21	EMUL PULSE NR	UINT32	0…65535	-	1 = 1		167	16	0		
93.22	EMUL POS REF	Val pointer		-			167	32	P.01.12 (P.04.17 for pos. appl.)		
95	HW CONFIGURATION										
95.01	CTRL UNIT SUPPLY	enum	0…1	-	1 = 1		179	16	0		

Index	Parameter	Type	Range	Unit	FbEq	Update time	Page no.	Data len.	Def	PT	
95.02	EXTERNAL CHOKE	enum	0…1	-	1 = 1		179	16	0		
97	USER MOTOR PAR										
97.01	USE GIVEN PARAMS	enum	0…1	-	1 = 1		180	16	0	WPD	
97.02	RS USER	REAL24	0…0.5	p.u.	1 = 100000		180	32	0		
97.03	RR USER	REAL24	0…0.5	p.u.	1 = 100000		180	32	0		
97.04	LM USER	REAL24	0…10	p.u.	1 = 100000		180	32	0		
97.05	SIGMAL USER	REAL24	0…1	p.u.	1 = 100000		180	32	0		
97.06	LD USER	REAL24	0…10	p.u.	1 = 100000		180	32	0		
97.07	LQ USER	REAL24	0…10	p.u.	1 = 100000		181	32	0		
97.08	PM FLUX USER	REAL24	0…2	p.u.	1 = 100000		181	32	0		
97.09	RS USER SI	REAL24	0…100	ohm	1 = 100000		181	32	0		
97.10	RR USER SI	REAL24	0…100	ohm	1 = 100000		181	32	0		
97.11	LM USER SI	REAL24	0…100000	mH	1 = 100000		181	32	0		
97.12	SIGL USER SI	REAL24	0…100000	mH	1 = 100000		181	32	0		
97.13	LD USER SI	REAL24	0…100000	mH	1 = 100000		181	32	0		
97.14	LQ USER SI	REAL24	0…100000	mH	1 = 100000		181	32	0		
98	MOTOR CALC VALUES										
98.01	TORQ NOM SCALE	UINT32	0…2147483	Nm	1 = 1000		182	32	0	WP	
98.02	POLEPAIRS	UINT32	0…1000	-	1 = 1		182	16	0	WP	
99	START-UP DATA										
99.01	LANGUAGE	enum		-	1 = 1		44	16			
99.02	MOTOR CATALOGUE	UINT32		-	1 = 1		44	16			
99.03	MOTOR SELECTION	UINT32		-	1 = 1		44	16			
99.04	MOTOR TYPE	enum	0…1	-	1 = 1		44	16	0	WPD	
99.05	MOTOR CTRL MODE	enum	0…1	-	1 = 1		45	16	0		
99.06	MOT NOM CURRENT	REAL	0…6400	A	1 = 10		45	32	0	WPD	
99.07	MOT NOM VOLTAGE	REAL	120…960	V	1 = 10		45	32	0	WPD	
99.08	MOT NOM FREQ	REAL	0…500	Hz	1 = 10		45	32	0	WPD	
99.09	MOT NOM SPEED	REAL	0…10000	rpm	1 = 1		46	32	0	WPD	
99.10	MOT NOM POWER	REAL	0…10000	kW	1 = 100		46	32	0	WPD	
99.11	MOT NOM COSFII	REAL24	0…1	-	1 = 100		46	32	0	WPD	
99.12	MOT NOM TORQUE	INT32	0…2147483	Nm	1 = 1000		46	32	0	WPD	
99.13	IDRUN MODE	enum	0…5	-	1 = 1		47	16	0	WPD	

Fault tracing

What this chapter contains

The chapter lists all alarm and fault messages including the possible cause and corrective actions.

Safety

WARNING! Only qualified electricians are allowed to maintain the drive. The *Safety Instructions* on the first pages of the appropriate hardware manual must be read before you start working with the drive.

Alarm and fault indications

An alarm or a fault message indicates abnormal drive status. Most alarm and fault causes can be identified and corrected using this information. If not, an ABB representative should be contacted.

The four-digit code number in brackets after the message is for the fieldbus communication.

The alarm/fault code is displayed on the 7-segment display of the drive. The following table describes the indications given by the 7-segment display.

Display	Meaning
“E” followed by error code	System error. See appropriate drive hardware manual.
“A” followed by error code	Alarm. See section Alarm messages generated by the drive on page 199.
“F” followed by error code	Fault. See section Fault messages generated by the drive on page 205.

How to reset

The drive can be reset either by pressing the reset key on the PC tool ( ) or control panel (***RESET***) or switching the supply voltage off for a while. When the fault has been removed, the motor can be restarted.

A fault can also be reset from an external source by parameter 10.08 FAULT RESET SEL.

Fault history

When fault is detected, it is stored in the fault logger with a time stamp. The fault history stores information on the 16 latest faults of the drive. Three of the latest faults are stored at the beginning of a power switch off.

Signals 8.01 ACTIVE FAULT and 8.02 LAST store the fault codes of the most recent faults.

Alarms can be monitored via alarm words 8.05…8.07 ALARM WORD 1…3. Alarm information is lost at power switch off or fault reset.

Alarm messages generated by the drive

Code	Alarm (fieldbus code)	Cause	What to do
2000	BRAKE START TORQUE (0x7185) Programmable fault: 35.09 BRAKE FAULT FUNC	Mechanical brake alarm. Alarm is activated if required motor starting torque, 35.06 BRAKE OPEN TORQ, is not achieved.	Check brake open torque setting, parameter 35.06. Check drive torque and current limits. See firmware block LIMITS on page 83.
2001	BRAKE NOT CLOSED (0x7186) Programmable fault: 35.09 BRAKE FAULT FUNC	Mechanical brake control alarm. Alarm is activated e.g. if brake acknowledgement is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings, parameters 35.01…35.09. To determine whether problem is with acknowledgement signal or brake: Check if brake is closed or open.
2002	BRAKE NOT OPEN (0x7187) Programmable fault: 35.09 BRAKE FAULT FUNC	Mechanical brake control alarm. Alarm is activated e.g. if brake acknowledgement is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings, parameters 35.01…35.08. To determine whether problem is with acknowledgement signal or brake: Check if brake is closed or open.
2003	SAFE TORQUE OFF (0xFF7A) Programmable fault: 46.07 STO DIAGNOSTIC	Safe Torque Off function is active, i.e. safety circuit signal(s) connected to connector X6 is lost while drive is stopped and parameter 46.07 STO DIAGNOSTIC setting is ALARM.	Check safety circuit connections. For more information, see appropriate drive hardware manual.
2004	STO MODE CHANGE (0xFF7A)	Error in changing Safe Torque Off supervision, i.e. parameter 46.07 STO DIAGNOSTIC setting could not be changed to value ALARM.	Contact your local ABB representative.
2005	MOTOR TEMPERATURE (0x4310) Programmable fault: 45.01 MOT TEMP PROT	Estimated motor temperature (based on motor thermal model) has exceeded alarm limit defined by parameter 45.03 MOT TEMP ALM LIM.	Check motor ratings and load. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc. Check value of alarm limit. Check motor thermal model settings, parameters 45.06…45.08 and 45.10 MOT THERM TIME.
		Measured motor temperature has exceeded alarm limit defined by parameter 45.03 MOT TEMP ALM LIM.	Check that actual number of sensors corresponds to value set by parameter 45.02 MOT TEMP SOURCE. Check motor ratings and load. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc. Check value of alarm limit.

Code	Alarm (fieldbus code)	Cause	What to do
2006	EMERGENCY OFF (0xF083)	Drive has received emergency OFF2 command.	To restart drive, activate RUN ENABLE signal (source selected by parameter 10.09 RUN ENABLE) and start drive.
2007	RUN ENABLE (0xFF54)	No Run enable signal is received.	Check setting of parameter 10.09 RUN ENABLE. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
2008	ID-RUN (0xFF84)	Motor identification run is on.	This alarm belongs to normal start-up procedure. Wait until drive indicates that motor identification is completed.
		Motor identification is required.	This alarm belongs to normal start-up procedure. Select how motor identification should be performed, parameter 99.13 ID RUN MODE. Start identification routines by pressing Start key.
2009	EMERGENCY STOP (0xF081)	Drive has received emergency stop command (OFF1/OFF3).	Check that it is safe to continue operation. Return emergency stop push button to normal position (or adjust the fieldbus Control Word accordingly). Restart drive.
2011	BR OVERHEAT (0x7112)	Brake resistor temperature has exceeded alarm limit defined by parameter 48.07 BR TEMP ALARMLIM.	Stop drive. Let resistor cool down. Check resistor overload protection function settings, parameters 48.03…48.05. Check alarm limit setting, parameter 48.07. Check that braking cycle meets allowed limits.
2012	BC OVERHEAT (0x7181)	Brake chopper IGBT temperature has exceeded internal alarm limit.	Let chopper cool down. Check resistor overload protection function settings, parameters 48.03…48.05. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
2013	DEVICE OVERTEMP (0x4210)	Measured drive temperature has exceeded internal alarm limit.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
2014	INTBOARD OVERTEMP (0x7182)	Interface board (between power unit and control unit) temperature has exceeded internal alarm limit.	Let drive cool down.
2015	BC MOD OVERTEMP (0x7183)	Input bridge or brake chopper temperature has exceeded internal alarm limit.	Let drive cool down.

Code	Alarm (fieldbus code)	Cause	What to do
2016	IGBT OVERTEMP (0x7184)	Drive temperature based on thermal model has exceeded internal alarm limit.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
2017	FIELDBUS COMM (0x7510) Programmable fault: 50.02 COMM LOSS FUNC	Cyclical communication between drive and fieldbus adapter module or between PLC and fieldbus adapter module is lost.	Check status of fieldbus communication. See appropriate User's Manual of fieldbus adapter module. Check fieldbus parameter settings. See firmware block FIELDBUS on page 142. Check cable connections. Check if communication master can communicate.
2018	LOCAL CTRL LOSS (0x5300) Programmable fault: 46.03 LOCAL CTRL LOSS	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Replace control panel in mounting platform.
2019	AI SUPERVISION (0x8110) Programmable fault: 13.12 AI SUPRVISION	Analogue input AI1 or AI2 signal has reached limit defined by parameter 13.13 AI SUPERVIS ACT.	Check analogue input AI1/2 source and connections. Check analogue input AI1/2 minimum and maximum limit settings, parameters 13.02 and 13.03 / 13.07 and 13.08.
2020	FB PAR CONF (0x6320)	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check fieldbus parameter settings. See firmware block FIELDBUS on page 142.
2021	NO MOTOR DATA (0x6381)	Parameters in group 99 have not been set.	Check that all the required parameters in group 99 have been set.
2022	ENCODER 1 FAILURE (0x7301)	Encoder 1 has been activated by parameter but the encoder interface (FEN-xx) cannot be found.	Check parameter 90.01 ENCODER 1 SEL setting corresponds to encoder interface 1 (FEN-xx) installed in drive Slot 1/2 (signal 9.20 OPTION SLOT 1 / 9.21 OPTION SLOT 2). **Note:** The new setting will only take effect after parameter 90.10 ENC PAR REFRESH is used or after the JCU control unit is powered up the next time.

Code	Alarm (fieldbus code)	Cause	What to do
2023	ENCODER 2 FAILURE (0x7381)	Encoder 2 has been activated by parameter but the encoder interface (FEN-xx) cannot be found.	Check parameter 90.02 ENCODER 2 SEL setting corresponds to encoder interface 2 (FEN-xx) installed in drive Slot 1/2 (signal 9.20 OPTION SLOT 1 / 9.21 OPTION SLOT 2). **Note:** The new setting will only take effect after parameter 90.10 ENC PAR REFRESH is used or after the JCU control unit is powered up the next time.
		EnDat or SSI encoder is used in continuous mode as encoder 2. [I.e. 90.02 ENCODER 2 SEL = FEN-11 ABS and 91.02 ABS ENC INTERF = EnDat (or 91.02 ABS ENC INTERF = SSI) and 91.30 ENDAT MODE = CONTINUOUS (or 91.25 SSI MODE = CONTINUOUS).]	If possible, use single position transfer instead of continuous position transfer (i.e. if encoder has incremental sin/cos signals): - Change parameter 91.25 SSI MODE / 91.30 ENDAT MODE to value INITIAL POS. Otherwise use Endat/SSI encoder as encoder 1: - Change parameter 90.01 ENCODER 1 SEL to value FEN-11 ABS and parameter 90.02 ENCODER 2 SEL to value NONE. **Note:** The new setting will only take effect after parameter 90.10 ENC PAR REFRESH is used or after the JCU control unit is powered up the next time.
2026	ENC EMULATION FAILURE (0x7384)	Encoder emulation error	If position value used in emulation is measured by encoder: - Check that FEN-xx encoder used in emulation (90.03 EMUL MODE SEL) corresponds to FEN-xx encoder interface 1 or (and) 2 activated by parameter 90.01/90.02 ENCODER 1/2. (Parameter 90.01/90.02 activates the position calculation of the used FEN-xx input). If position value used in emulation is determined by drive software: - Check that FEN-xx encoder used in emulation (90.03 EMUL MODE SEL) corresponds to FEN-xx encoder interface 1 or (and) 2 activated by parameter 90.01/90.02 ENCODER 1/2 (because position data used in emulation is written to FEN-xx during encoder data request). Encoder interface 2 is recommended. **Note:** The new setting will only take effect after parameter 90.10 ENC PAR REFRESH is used or after the JCU control unit is powered up the next time.

Code	Alarm (fieldbus code)	Cause	What to do
2027	FEN TEMP MEAS FAILURE (0x7385)	Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used.	Check that parameter 45.02 MOT TEMP SOURCE settings correspond to encoder interface installation (9.20 OPTION SLOT 1 / 9.21 OPTION SLOT 2): If one FEN-xx module is used: - Parameter 45.02 MOT TEMP SOURCE setting must be either KTY 1st FEN or PTC 1st FEN. FEN-xx module can be in either Slot 1 or Slot 2. If two FEN-xx modules are used: - When parameter 45.02 MOT TEMP SOURCE setting is KTY 1st FEN or PTC 1st FEN, the encoder installed in drive Slot 1 is used. - When parameter 45.02 MOT TEMP SOURCE setting is KTY 2nd FEN or PTC 2nd FEN, the encoder installed in drive Slot 2 is used.
		Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 is used.	FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
2028	ENC EMUL MAX FREQ (0x7386)	TTL pulse frequency used in encoder emulation.exceeds maximum allowed limit (500 kHz).	Decrease parameter 93.21 EMUL PULSE NR value. **Note:** The new setting will only take effect after parameter 90.10 ENC PAR REFRESH is used or after the JCU control unit is powered up the next time.
2029	ENC EMUL REF ERROR (0x7387)	Encoder emulation has failed due to failure in writing new (position) reference for emulation.	Contact your local ABB representative.
2030	RESOLVER AUTOTUNE ERR (0x7388)	Resolver autotuning routines, which are automatically started when resolver input is activated for the first time, have failed.	Check cable between resolver and resolver interface module (FEN-21) and order of connector signal wires at both ends of cable. Check resolver parameter settings. For resolver parameters and information, see firmware block RESOLVER CONF on page 174. **Note:** Resolver autotuning routines should always be performed after resolver cable connection has been modified. Autotuning routines can be activated by setting parameter 92.02 EXC SIGNAL AMPL or 92.03 EXC SIGNAL FREQ, and then setting parameter 90.10 ENC PAR REFRESH to 1.

Code	Alarm (fieldbus code)	Cause	What to do
2031	ENCODER 1 CABLE (0x7389)	Encoder 1 cable fault detected.	Check cable between FEN-xx interface and encoder 1. After any modifications in cabling, re-configure interface by switching drive power off and on, or by activating parameter 90.10 ENC PAR REFRESH.
2032	ENCODER 2 CABLE (0x738A)	Encoder 2 cable fault detected.	Check cable between FEN-xx interface and encoder 2. After any modifications in cabling, re-configure interface by switching drive power off and on, or by activating parameter 90.10 ENC PAR REFRESH.
2033	D2D COMMUNICATION (0x7520) Programmable fault: 57.02 COMM LOSS FUNC	Drive-to-drive communication break detected.	Check the drive-to-drive cabling.
2035	PS COMM (0x5480)	Communication errors detected between the JCU Control Unit and the power unit of the drive.	Check the connections between the JCU Control Unit and the power unit.
2036	RESTORE (0x6300)	Restore of backed-up parameters failed.	Contact your local ABB representative.
2037	CUR MEAS CALIBRATION (0x2280)	Current measurement calibration will occur at next start.	Informative alarm.
2038	AUTOPHASING (0x3187)	Autophasing will occur at next start.	Informative alarm.
2039	EARTH FAULT (0x2330) Programmable fault: 46.05 EARTH FAULT	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check that there is no earth fault in motor or motor cables: - measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.

Fault messages generated by the drive

Code	Fault (fieldbus code)	Cause	What to do
0001	OVERCURRENT (0x2310)	Output current has exceeded internal fault limit.	Check motor load. Check acceleration time. See firmware block SPEED REF RAMP on page 97. Check motor and motor cable (including phasing and delta/star connection). Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).
0002	DC OVERVOLTAGE (0x3210)	Excessive intermediate circuit DC voltage	Check that overvoltage controller is on, parameter 47.01 OVERVOLTAGE CTRL. Check mains for static or transient overvoltage. Check brake chopper and resistor (if used). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit frequency converter with brake chopper and brake resistor.
0003	DEVICE OVERTEMP (0x4210)	Measured drive temperature has exceeded internal fault limit.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
0004	SHORT CIRCUIT (0x2340)	Short-circuit in motor cable(s) or motor	Check motor and motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable.
0005	DC UNDERVOLTAGE (0x3220)	Intermediate circuit DC voltage is not sufficient due to missing mains phase, blown fuse or rectifier bridge internal fault.	Check mains supply and fuses.
0006	EARTH FAULT (0x2330) Programmable fault: 46.05 EARTH FAULT	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check that there is no earth fault in motor or motor cables: - measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.
0007	FAN FAULT (0xFF83)	Fan is not able to rotate freely or fan is disconnected. Fan operation is monitored by measuring fan current.	Check fan operation and connection.

Code	Fault (fieldbus code)	Cause	What to do
0008	IGBT OVERTEMP (0x7184)	Drive temperature based on thermal model has exceeded internal fault limit.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
0009	BC WIRING (0x7111)	Brake resistor short circuit or brake chopper control fault	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged.
0010	BC SHORT CIRCUIT (0x7113)	Short circuit in brake chopper IGBT	Replace brake chopper. Ensure brake resistor is connected and not damaged.
0011	BC OVERHEAT (0x7181)	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check resistor overload protection function settings, parameters 48.03…48.05. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
0012	BR OVERHEAT (0x7112)	Brake resistor temperature has exceeded fault limit defined by parameter 48.06 BR TEMP FAULTLIM.	Stop drive. Let resistor cool down. Check resistor overload protection function settings, parameters 48.03…48.05. Check fault limit setting, parameter 48.06. Check that braking cycle meets allowed limits.
0013	CURR MEAS GAIN (0x3183)	Difference between output phase U2 and W2 current measurement gain is too great.	Contact your local ABB representative.
0014	CABLE CROSS CON (0x3181) Programmable fault: 46.08 CROSS CONNECTION	Incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).	Check input power connections.
0015	SUPPLY PHASE (0x3130) Programmable fault: 46.06 SUPPL PHS LOSS.	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for input power supply imbalance.
0016	MOTOR PHASE (0x3182) Programmable fault: 46.04 MOT PHASE LOSS	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.

Code	Fault (fieldbus code)	Cause	What to do
0017	ID-RUN FAULT (0xFF84)	Motor ID Run is not completed successfully.	Check motor settings, parameters 99.04…99.13. Check that no limits prevent ID run. Following must apply: 20.05 MAXIMUM CURRENT ≥ 99.06 MOT NOM CURRENT for Reduced and Normal ID run: - 20.01 MAXIMUM SPEED > 55% of 99.09 MOT NOM SPEED - 20.02 MINIMUM SPEED ≤ 0 - supply voltage must be ≥ 65% of 99.07 MOT NOM VOLTAGE - 20.06 MAXIMUM TORQUE ≥ 100% (only for Normal ID run). Retry.
0018	CURR U2 MEAS (0x3184)	Measured offset error of U2 output phase current measurement is too great. (Offset value is updated during current calibration.)	Contact your local ABB representative.
0019	CURR V2 MEAS (0x3185)	Measured offset error of V2 output phase current measurement is too great. (Offset value is updated during current calibration.)	Contact your local ABB representative.
0020	CURR W2 MEAS (0x3186)	Measured offset error of W2 output phase current measurement is too great. (Offset value is updated during current calibration.)	Contact your local ABB representative.
0021	STO1 LOST (0x8182)	Safe Torque Off function is active, i.e. safety circuit signal 1 connected between X6:1 and X6:3 is lost while drive is at stopped state and parameter 46.07 STO DIAGNOSTIC setting is ALARM or NO.	Check safety circuit connections. For more information, see appropriate drive hardware manual.
0022	STO2 LOST (0x8183)	Safe Torque Off function is active, i.e. safety circuit signal 2 connected between X6:2 and X6:4 is lost while drive is at stopped state and parameter 46.07 STO DIAGNOSTIC setting is ALARM or NO.	Check safety circuit connections. For more information, see appropriate drive hardware manual.
0023	STO MODE CHANGE (0xFF7A)	Error in changing Safe Torque Off supervision, i.e. parameter 46.07 STO DIAGNOSTIC setting could not be changed to value FAULT.	Contact your local ABB representative.

Code	Fault (fieldbus code)	Cause	What to do
0024	INTBOARD OVERTEMP (0x7182)	Interface board (between power unit and control unit) temperature has exceeded internal fault limit.	Let drive cool down.
0025	BC MOD OVERTEMP (0x7183)	Input bridge or brake chopper temperature has exceeded internal fault limit.	Let drive cool down.
0027	PU LOST (0x5400)	Connection between the JCU Control Unit and the power unit of the drive is lost.	Check the connections between the JCU Control Unit and the power unit.
0028	PS COMM (0x5480)	Communication errors detected between the JCU Control Unit and the power unit of the drive.	Check the connections between the JCU Control Unit and the power unit.
0030	EXTERNAL (0x9000)	Fault in external device. (This information is configured through one of programmable digital inputs.)	Check external devices for faults. Check parameter 46.01 EXTERNAL FAULT setting.
0031	SAFE TORQUE OFF (0xFF7A) Programmable fault: 46.07 STO DIAGNOSTIC	Safe Torque Off function is active, i.e. safety circuit signal(s) connected to connector X6 is lost - during drive start or drive run or - while drive is stopped and parameter 46.07 STO DIAGNOSTIC setting is FAULT.	Check safety circuit connections. For more information, see appropriate drive hardware manual.
0032	OVERSPEED (0x7310)	Motor is turning faster than highest allowed speed due to incorrectly set minimum/ maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters 20.01 MAXIMUM SPEED and 20.02 MINIMUM SPEED. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
0033	BRAKE START TORQUE (0x7185) Programmable fault: 35.09 BRAKE FAULT FUNC	Mechanical brake fault. Fault is activated if required motor starting torque, 35.06 BRAKE OPEN TORQ, is not achieved.	Check brake open torque setting, parameter 35.06. Check drive torque and current limits. See firmware block LIMITS on page 83.
0034	BRAKE NOT CLOSED (0x7186) Programmable fault: 35.09 BRAKE FAULT FUNC	Mechanical brake control fault. Fault is activated if brake acknowledgement is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings, parameters 35.01…35.09. To determine whether problem is with acknowledgement signal or brake: Check if brake is closed or open.

Code	Fault (fieldbus code)	Cause	What to do
0035	BRAKE NOT OPEN (0x7187) Programmable fault: 35.09 BRAKE FAULT FUNC	Mechanical brake control fault. Fault is activated if brake acknowledgement is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings, parameters 35.01…35.08. To determine whether problem is with acknowledgement signal or brake: Check if brake is closed or open.
0036	LOCAL CTRL LOSS (0x5300) Programmable fault: 46.03 LOCAL CTRL LOSS	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Replace control panel in mounting platform.
0037	NVMEMCORRUPTED (0x6320)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0038	OPTION COMM LOSS (0x7000)	Communication between drive and option module (FEN-xx and/or FIO-xx) is lost.	Check that option modules are properly connected to Slot 1 and (or) Slot 2. Check that option modules or Slot 1/2 connectors are not damaged. To determine whether module or connector is damaged: Test each module individually in Slot 1 and Slot 2.

Code	Fault (fieldbus code)	Cause	What to do
0039	ENCODER1 (0x7301)	Encoder 1 feedback fault	If fault appears during first start-up before encoder feedback is used: - Check cable between encoder and encoder interface module (FEN-xx) and order of connector signal wires at both ends of cable. If absolute encoder, EnDat/Hiperface/SSI, with incremental sin/cos pulses is used, incorrect wiring can be located as follows: Disable serial link (zero position) by setting parameter *91.02* to 0 and test encoder operation: - If encoder fault is not activated, check serial link data wiring. Note that zero position is not taken into account when serial link is disabled. - If encoder fault is activated, check serial link and sin/cos signal wiring. **Note:** Because only zero position is requested through serial link and during run, position is updated according to sin/cos pulses. - Check encoder parameter settings. If fault appears after encoder feedback has already been used or during drive run: - Check that encoder connection wiring or encoder is not damaged. - Check that encoder interface module (FEN-xx) connection or module is not damaged. - Check earthings (when disturbances are detected in communication between encoder interface module and encoder). For more information on encoders, see firmware blocks ENCODER (on page 164), ABSOL ENC CONF (on page 169), RESOLVER CONF (on page 174)and PULSE ENC CONF (on page 176.).

Code	Fault (fieldbus code)	Cause	What to do
0040	ENCODER2 (0x7381)	Encoder 2 feedback fault	See fault ENCODER1.
		EnDat or SSI encoder is used in continuous mode as encoder 2. [I.e. 90.02 ENCODER 2 SEL = FEN-11 ABS and 91.02 ABS ENC INTERF = EnDat (or 91.02 ABS ENC INTERF = SSI) and 91.30 ENDAT MODE = CONTINUOUS (or 91.25 SSI MODE = CONTINUOUS).]	If possible, use single position transfer instead of continuous position transfer (i.e. if encoder has incremental sin/cos signals): - Change parameter 91.25 SSI MODE / 91.30 ENDAT MODE to value INITIAL POS. Otherwise use Endat/SSI encoder as encoder 1: - Change parameter 90.01 ENCODER 1 SEL to value FEN-11 ABS and parameter 90.02 ENCODER 2 SEL to value NONE. **Note:** The new setting will only take effect after parameter 90.10 ENC PAR REFRESH is used or after the JCU control unit is powered up the next time.
0045	FIELDBUS COMM (0x7510) Programmable fault: 50.02 COMM LOSS FUNC	Cyclical communication between drive and fieldbus adapter module or between PLC and fieldbus adapter module is lost.	Check status of fieldbus communication. See appropriate User's Manual of fieldbus adapter module. Check fieldbus parameter settings. See firmware block FIELDBUS on page 142. Check cable connections. Check if communication master can communicate.
0046	FB MAPPING FILE (0x6306)	Drive internal fault	Contact your local ABB representative.
0047	MOTOR OVERTEMP (0x4310) Programmable fault: 45.01 MOT TEMP PROT	Estimated motor temperature (based on motor thermal model) has exceeded fault limit defined by parameter 45.04 MOT TEMP FLT LIM.	Check motor ratings and load. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc. Check value of fault limit. Check motor thermal model settings, parameters 45.06…45.08 and 45.10 MOT THERM TIME.
		Measured motor temperature has exceeded fault limit defined by parameter 45.04 MOT TEMP FLT LIM.	Check that actual number of sensors corresponds to value set by parameter 45.02 MOT TEMP SOURCE. Check motor ratings and load. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc. Check value of fault limit.

Code	Fault (fieldbus code)	Cause	What to do
0049	AI SUPERVISION (0x8110) Programmable fault: 13.12 AI SUPERVISION	Analogue input AI1 or AI2 signal has reached limit defined by parameter 13.13 AI SUPERVIS ACT.	Check analogue input AI1/2 source and connections. Check analogue input AI1/2 minimum and maximum limit settings, parameters 13.02 and 13.03 / 13.07 and 13.08.
0050	ENCODER 1 CABLE (0x7389) Programmable fault: 90.05 ENC CABLE FAULT	Encoder 1 cable fault detected.	Check cable between FEN-xx interface and encoder 1. After any modifications in cabling, re-configure interface by switching drive power off and on, or by activating parameter 90.10 ENC PAR REFRESH.
0051	ENCODER 2 CABLE (0x738A) Programmable fault: 90.05 ENC CABLE FAULT	Encoder 2 cable fault detected.	Check cable between FEN-xx interface and encoder 2. After any modifications in cabling, re-configure interface by switching drive power off and on, or by activating parameter 90.10 ENC PAR REFRESH.
0052	D2D CONFIG (0x7583) Programmable fault: 57.02 COMM LOSS FUNC	The drive-to-drive link configuration detected by the master drive does not match the polling parameters.	Check that all drives that are polled by the master (parameters 57.04 and 57.05) on the drive-to-drive link are powered, properly connected to the link, and have the correct node address.
0053	D2D COMMUNICATION (0x7520) Programmable fault: 57.02 COMM LOSS FUNC	Drive-to-drive communication break detected.	Check the drive-to-drive cabling.
0055	TECH LIB (0x6382)	Resettable fault generated by a technology library.	Refer to the documentation of the technology library.
0056	TECH LIB CRITICAL (0x6382)	Permanent fault generated by a technology library.	Refer to the documentation of the technology library.
0057	FORCED TRIP (0xFF90)	Generic Drive Communication Profile trip command.	Check PLC status.
0058	FIELDBUS PAR ERROR (0x6320)	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check fieldbus parameter settings. See firmware block FIELDBUS on page 142.
0201	T2 OVERLOAD (0x0201)	Firmware time level 2 overload **Note:** This fault cannot be reset.	Contact your local ABB representative.
0202	T3 OVERLOAD (0x6100)	Firmware time level 3 overload **Note:** This fault cannot be reset.	Contact your local ABB representative.
0203	T4 OVERLOAD (0x6100)	Firmware time level 4 overload **Note:** This fault cannot be reset.	Contact your local ABB representative.

Code	Fault (fieldbus code)	Cause	What to do
0204	T5 OVERLOAD (0x6100)	Firmware time level 5 overload **Note:** This fault cannot be reset.	Contact your local ABB representative.
0205	A1 OVERLOAD (0x6100)	Application time level 1 fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0206	A2 OVERLOAD (0x6100)	Application time level 2 fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0207	A1 INIT FAULT (0x6100)	Application task creation fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0208	A2 INIT FAULT (0x6100)	Application task creation fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0209	STACK ERROR (0x6100)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0210	FPGA ERROR (0xFF61)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0301	UFF FILE READ (0x6300)	File read error **Note:** This fault cannot be reset.	Contact your local ABB representative.
0302	APPL DIR CREATION (0x6100)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0303	FPGA CONFIG DIR (0x6100)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0304	PU RATING ID (0x5483)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0305	RATING DATABASE (0x6100)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0306	LICENSING (0x6100)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.
0307	DEFAULT FILE (0x6100)	Drive internal fault **Note:** This fault cannot be reset.	Contact your local ABB representative.

Code	Fault (fieldbus code)	Cause	What to do
0308	APPL FILE PAR CONF (0x6300)	Corrupted application file **Note:** This fault cannot be reset.	Reload application. If fault is still active, contact your local ABB representative.
0309	APPL LOADING (0x6300)	Corrupted application file **Note:** This fault cannot be reset.	Reload application. If fault is still active, contact your local ABB representative.
0310	USERSET LOAD (0xFF69)	Loading of user set is not successfully completed because: - requested user set does not exist - user set is not compatible with drive program - drive has been switched off during loading.	Reload.
0311	USERSET SAVE (0xFF69)	User set is not saved because of memory corruption.	Check the setting of parameter 95.01. If the fault still occurs, contact your local ABB representative.
0312	UFF OVERSIZE (0x6300)	UFF file is too big.	Contact your local ABB representative.
0313	UFF EOF (0x6300)	UFF file structure failure	Delete faulty file or contact your local ABB representative.
0314	TECH LIB INTERFACE (0x6100)	Incompatible firmware interface **Note:** This fault cannot be reset.	Contact your local ABB representative.
0315	RESTORE FILE (0x630D)	Restore of backed-up parameters failed.	Contact your local ABB representative.
0316	DAPS MISMATCH (0x5484)	Mismatch between JCU Control Unit firmware and power unit logic versions.	Contact your local ABB representative.

Standard function blocks

What this chapter contains

This chapter describes the standard function blocks.

The number in brackets in the standard block heading is the block number.

Note: The given execution times can vary depending on the used drive application.

Terms

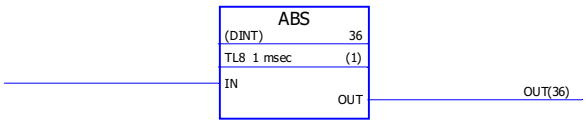
Data type	Description	Range
Boolean	Boolean	
DINT	32-bit integer value (31 bits + sign)	-2147483648…2147483647
INT	16-bit integer value (15 bits + sign)	-32768…32767
REAL	16-bit value 16-bit value (31 bits + sign) = integer value = fractional value	-32768,99998…32767,9998
REAL24	8-bit value 24-bit value (31 bits + sign) = integer value = fractional value	-128,0…127,999

ABS

(10001)

Type Arithmetic

Illustration



Execution time 0.53 µs

Operation The output (OUT) is the absolute value of the input (IN).

OUT = | IN |

Inputs The input data type is selected by the user.

Input (IN): DINT, INT, REAL or REAL24

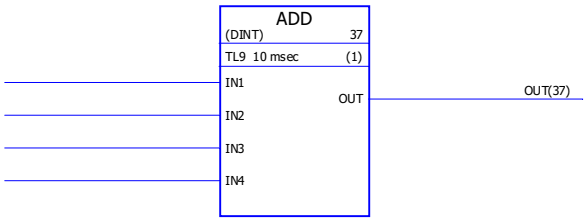
Outputs Output (OUT): DINT, INT, REAL or REAL24

ADD

(10000)

Type Arithmetic

Illustration



Execution time 3.36 µs (when two inputs are used) + 0.52 µs (for every additional input). When all inputs are used, the execution time is 18.87 µs.

Operation The output (OUT) is the sum of the inputs (IN1…IN32).

OUT = IN1 + IN2 + … + IN32

The output value is limited to the maximum and minimum values defined by the selected data type range.

Inputs The input data type and the number of the inputs (2…23) are selected by the user.

Input (IN1…IN32): DINT, INT, REAL or REAL24

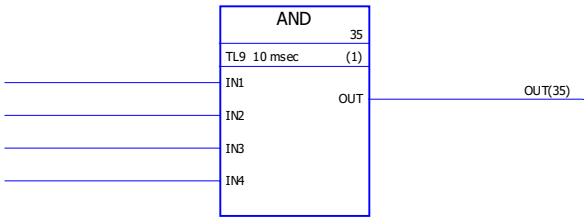
Outputs Output (OUT): DINT, INT, REAL or REAL24

AND

(10010)

Type Bit string

Illustration



Execution time 1.55 µs (when two inputs are used) + 0.60 µs (for every additional input). When all inputs are used, the execution time is 19.55 µs.

Operation The output (OUT) is 1 if all the connected inputs (IN1…IN32) are 1. Otherwise the output is 0.

Truth table:

IN1	IN2	OUT
0	0	0
0	1	0
1	0	0
1	1	1

The inputs can be inverted.

Inputs The number of inputs is selected by the user.

Input (IN1…IN32): Boolean

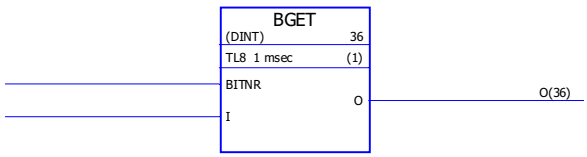
Outputs Output (OUT): Boolean

BGET

(10034)

Type Bitwise

Illustration



Execution time 0.88 µs

Operation The output (O) is the value of the selected bit (BITNR) of the input (I).

BITNR: Bit number (0 = bit number 0, 31 = bit number 31)

If bit number is not in the range of 0…31 (for DINT) or 0…15 (for INT), the output is 0.

Inputs The input data type is selected by the user.

Number of the bit (BITNR): DINT

Input (I): DINT, INT

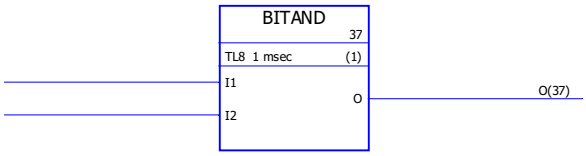
Outputs Output (O): Boolean

BITAND

(10035)

Type Bitwise

Illustration



Execution time 0.32 µs

Operation The output (O) bit value is 1 if the corresponding bit values of the inputs (I1 and I2) are 1. Otherwise the output bit value is 0.

Example:

I1	1	1	1	0	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	0	1	0	1
I2	0	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	0	1	0	1	1	1	1
O	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	0	1

Inputs Input (I1, I2): DINT

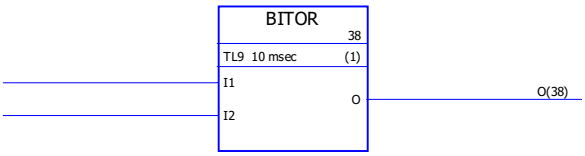
Outputs Output (O): DINT

BITOR

(10036)

Type Bitwise

Illustration



Execution time 0.32 µs

Operation The output (O) bit value is 1 if the corresponding bit value of any of the inputs (I1 or I2) is 1. Otherwise the output bit value is 0.

Example:

I1	1	1	1	0	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	0	1	0	1
I2	0	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	0	1	0	1	1	1	1
O	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1	1	1	1

Input Input (I1, I2): DINT

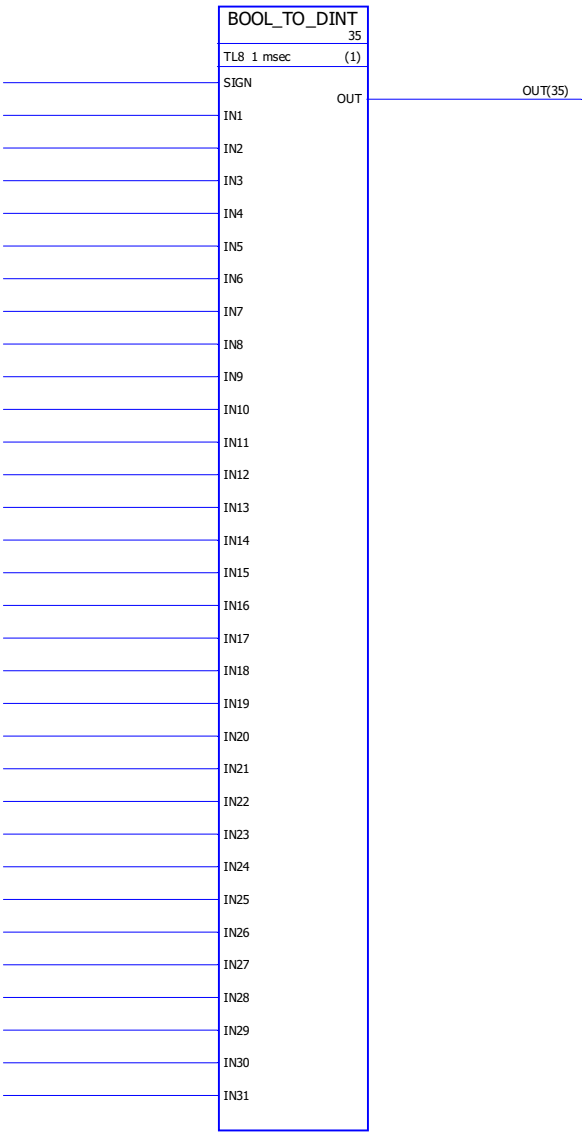
Output Output (O): DINT

BOOL_TO_DINT

(10018)

Type Conversion

Illustration



Execution time 13.47 µs

Operation The output (OUT) value is a 32-bit integer value formed from the boolean integer input (IN1…IN31 and SIGN) values. IN1 = bit 0 and IN31 = bit 30.

Example:

IN1 = 1, IN2 = 0, IN3…IN31 = 1, SIGN = 1

OUT = 1111 1111 1111 1111 1111 1111 1111 1101

SIGN IN31…IN1

Input Sign input (SIGN): Boolean

Input (IN1…IN31): Boolean

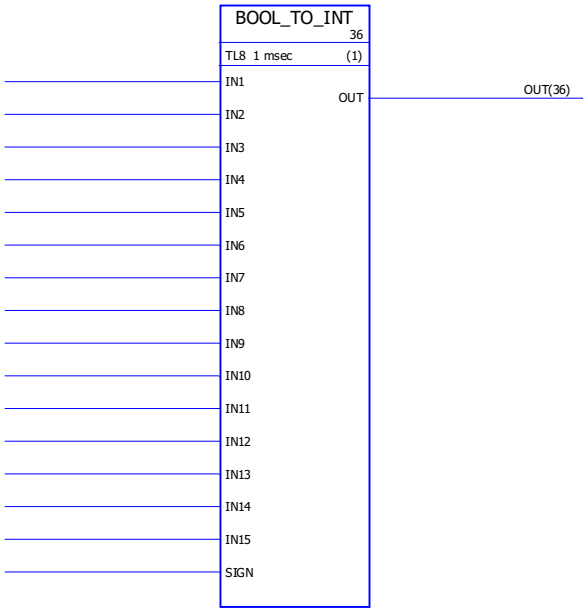
Output Output (OUT): DINT (31 bits + sign)

BOOL_TO_INT

(10019)

Type Conversion

Illustration



Execution time 5.00 µs

Operation The output (OUT) value is a 16-bit integer value formed from the boolean integer input (IN1…IN1 and SIGN) values. IN1 = bit 0 and IN15 = bit 14.

Example:

IN1…IN15 = 1, SIGN = 0

OUT = 0111 1111 1111 1111

SIGN IN15…IN1

Inputs Input (IN1…IN15): Boolean

Sign input (SIGN): Boolean

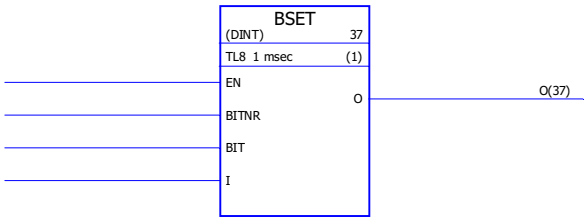
Outputs Output (OUT): DINT (15 bits + sign)

BSET

(10037)

Type Bitwise

Illustration



Execution time 1.36 µs

Operation The value of a selected bit (BITNR) of the input (I) is set as defined by the bit value input (BIT). The function must be enabled by the enable input (EN).

BITNR: Bit number (0 = bit number 0, 31 = bit number 31)

If BITNR is not in the range of 0…31 (for DINT) or 0…15 (for INT) or if EN is reset to zero, the input value is stored to the output as it is (i.e. no bit setting occurs).

Example:

EN = 1, BITNR = 3, BIT = 0

IN = 0000 0000 1111 1111

O = 0000 0000 1111 0111

Inputs The input data type is selected by the user.

Enable input (EN): Boolean

Number of the bit (BITNR): DINT

Bit value input (BIT): Boolean

Input (I): INT, DINT

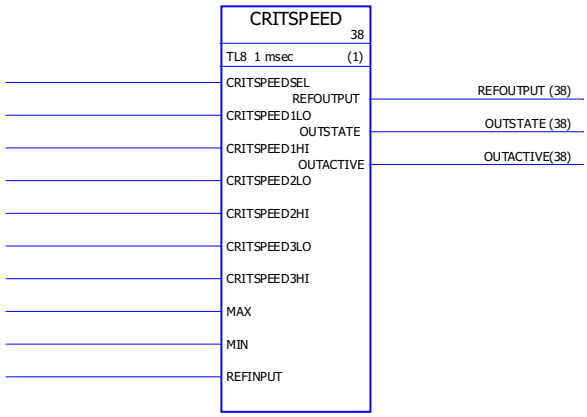
Outputs Output (O): INT, DINT

CRITSPEED

(10068)

Type Feedback & algorithms

Illustration

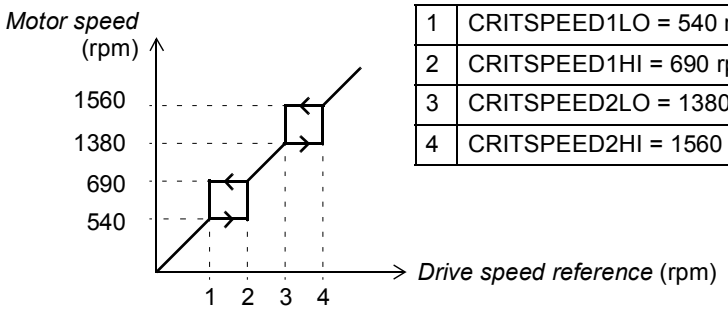


Execution time 4.50 µs

Operation A critical speeds function block is available for applications where it is necessary to avoid certain motor speeds or speed bands because of e.g. mechanical resonance problems. The user can define three critical speeds or speed bands.

Example: An application has vibrations in the range of 540 to 690 rpm and 1380 to 1560 rpm. To make the drive made to jump over the vibration speed ranges:

- activate the critical speeds function (CRITSPEEDSEL = 1),
- set the critical speed ranges as in the figure below.



1	CRITSPEED1LO = 540 rpm
2	CRITSPEED1HI = 690 rpm
3	CRITSPEED2LO = 1380 rpm
4	CRITSPEED2HI = 1560 rpm

Output OUTACTIVE is set to 1 when the output reference (REFOUTPUT) is different from the input reference (REFINPUT).

The output is limited by the defined minimum and maximum limits (MIN and MAX).

Output OUTSTATE indicates in which critical speed range the operation point is.

Inputs Critical speed activation input (CRITSPEEDSEL): Boolean

Reference input (REFINPUT): REAL

Minimum/maximum critical speed range input (CRITSPEEDNLO / CRITSPEEDNHI): REAL

Minimum/maximum input (MIN/MAX): REAL

Outputs Reference output (REFOUTPUT): REAL

Output state (OUTSTATE): REAL

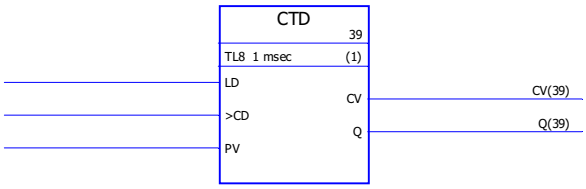
Output active (OUTACTIVE): Boolean

CTD

(10047)

Type Counter

Illustration



Execution time 0.92 µs

Operation The counter output (CV) value is decreased by 1 if the counter input (CD) value changes from 0 -> 1 and the load input (LD) value is 0. If the load input value is 1, the preset input (PV) value is stored as the counter output (CV) value. If the counter output has reached its minimum value -32768, the counter output remains unchanged.

The status output (Q) is 1 if the counter output (CV) value ≤ 0.

Example:

LD	**CD**	**PV**	**Q**	**CV_{prev}**	**CV**
0	1 -> 0	10	0	5	5
0	0 -> 1	10	0	5	5 - 1 = 4
1	1 -> 0	-2	1	4	-2
1	0 -> 1	1	0	-2	1
0	0 -> 1	5	1	1	1 -1 = 0
1	1 -> 0	-32768	1	0	-32768
0	0 -> 1	10	1	-32768	-32768
CV_{prev} is the previous cycle counter output value.					

Inputs Counter input (CD): Boolean

Load input (LD): Boolean

Preset input (PV): INT

Outputs Status output (Q): Boolean

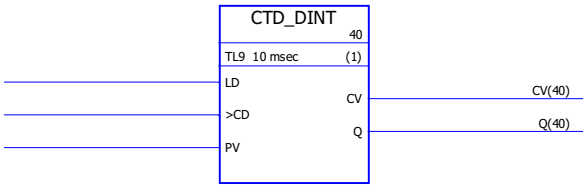
Counter output (CV): INT

CTD_DINT

(10046)

Type Counter

Illustration



Execution time 0.92 µs

Operation The counter output (CV) value is decreased by 1 if the counter input (CD) value changes from 0 -> 1 and the load input (LD) value is 0. If the load input (LD) value is 1, the preset input (PV) value is stored as the counter output (CV) value. If the counter output has reached its minimum value -2147483648, the counter output remains unchanged.

The status output (Q) is 1 if the counter output (CV) value ≤ 0.

Example:

LD	**CD**	**PV**	**Q**	**CV_{prev}**	**CV**
0	1 -> 0	10	0	5	5
0	0 -> 1	10	0	5	5 - 1 = 4
1	1 -> 0	-2	1	4	-2
1	0 -> 1	1	0	-2	1
0	0 -> 1	5	1	1	1 -1 = 0
1	1 -> 0	-2147483648	1	0	-2147483648
0	0 -> 1	10	1	-2147483648	-2147483648
CV_{prev} is the previous cycle counter output value.					

Inputs Counter input (CD): Boolean
Load input (LD): Boolean
Preset input (PV): DINT

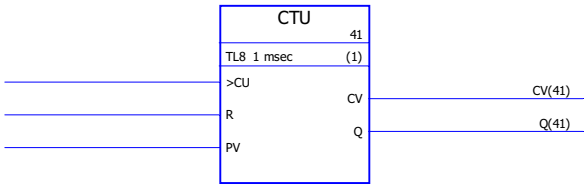
Outputs Status output (Q): Boolean
Counter output (CV): DINT

CTU

(10049)

Type Counter

Illustration



Execution time 0.92 µs

Operation The counter output (CV) value is increased by 1 if the counter input (CU) value changes from 0 -> 1 and the reset input (R) value is 0. If the counter output has reached its maximum value 32767, the counter output remains unchanged.

The counter output (CV) is reset to 0 if the reset input (R) is 1.

The status output (Q) is 1 if the counter output (CV) value ≥ preset input (PV) value.

Example:

R	CU	PV	Q	CV_{prev}	CV
0	1 -> 0	20	0	10	10
0	0 -> 1	11	1	10	10 + 1 = 11
1	1 -> 0	20	0	11	0
1	0 -> 1	5	0	0	0
0	0 -> 1	20	0	0	0 + 1 = 1
0	0 -> 1	30	1	32767	32767
CV_{prev} is the previous cycle counter output value.					

Inputs Counter input (CU): Boolean

Reset input (R): Boolean

Preset input (PV): INT

Outputs Status output (Q): Boolean

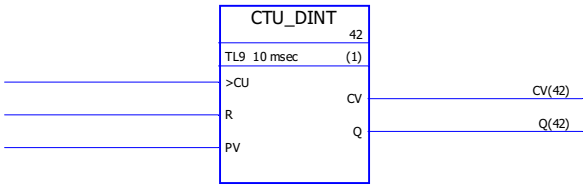
Counter output (CV): INT

CTU_DINT

(10048)

Type Counter

Illustration



Execution time 0.92 µs

Operation The counter output (CV) value is increased by 1 if the counter input (CU) value changes from 0 -> 1 and the reset input (R) value is 0. If the counter output has reached its maximum value 2147483647, the counter output remains unchanged.

The counter output (CV) is reset to 0 if the reset input (R) is 1.

The status output (Q) is 1 if the counter output (CV) value ≥ preset input (PV) value.

Example:

R	**CU**	**PV**	**Q**	**CV_{prev}**	**CV**
0	1 -> 0	20	0	10	10
0	0 -> 1	11	1	10	10 + 1 = 11
1	1 -> 0	20	0	11	0
1	0 -> 1	5	0	0	0
0	0 -> 1	20	0	0	0 + 1 = 1
0	0 -> 1	30	1	2147483647	2147483647
CV_{prev} is the previous cycle counter output value.					

Inputs Counter input (CU): Boolean

Reset input (R): Boolean

Preset input (PV): DINT

Outputs Status output (Q): Boolean

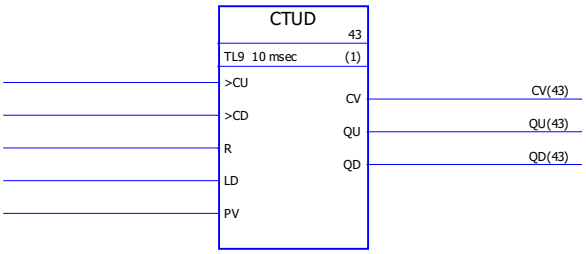
Counter output (CV): DINT

CTUD

(10051)

Type Counter

Illustration



Execution time 1.40 µs

Operation The counter output (CV) value is increased by 1 if the counter input (CU) value changes from 0 -> 1 and the reset input (R) value is 0.

The counter output (CV) value is decreased by 1 if the counter input (CD) value changes from 0 -> 1 and the load input (LD) value is 0.

If the load input (LD) value is 1, the preset input (PV) value is stored as the counter output (CV) value.

The counter output (CV) is reset to 0 if the reset input (R) is 1.

If the counter output has reached its minimum or maximum value, -32768 or +32767, the counter output remains unchanged until it is reset (R) or until the load input (LD) is set to 1.

The up counter status output (QU) is 1 if the counter output (CV) value $\geq$ preset input (PV) value.

The down counter status output (QD) is 1 if the counter output (CV) value $\leq$ 0.

Example:

CU	**CD**	**R**	**LD**	**PV**	**QU**	**QD**	**CV_{prev}**	**CV**
0 -> 0	0 -> 0	0	0	2	0	1	0	0
0 -> 0	0 -> 0	0	1	2	1	0	0	2
0 -> 0	0 -> 0	1	0	2	0	1	2	0
0 -> 0	0 -> 0	1	1	2	0	1	0	0
0 -> 0	0 -> 1	0	0	2	0	1	0	0 - 1 = -1
0 -> 0	1 -> 1	0	1	2	1	0	-1	2
0 -> 0	1 -> 1	1	0	2	0	1	2	0
0 -> 0	1 -> 1	1	1	2	0	1	0	0
0 -> 1	1 -> 0	0	0	2	0	0	0	0 + 1 = 1
1 -> 1	0 -> 0	0	1	2	1	0	1	2
1 -> 1	0 -> 0	1	0	2	0	1	2	0
1 -> 1	0 -> 0	1	1	2	0	1	0	0
1 -> 1	0 -> 1	0	0	2	0	1	0	0 - 1 = -1
1 -> 1	1 -> 1	0	1	2	1	0	-1	2
1 -> 1	1 -> 1	1	0	2	0	1	2	0
1 -> 1	1 -> 1	1	1	2	0	1	0	0
CV_{prev} is the previous cycle counter output value.								

Inputs Down counter input (CD): Boolean

Up counter input (CU): Boolean

Load input (LD): Boolean

Reset input (R): Boolean

Preset input (PV): INT

Outputs Down counter status output (QD): Boolean

Up counter status output (QU): Boolean

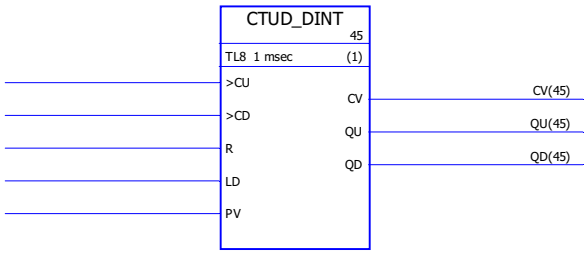
Counter output (CV): INT

CTUD_DINT

(10050)

Type Counter

Illustration



Execution time 1.40 µs

Operation The counter output (CV) value is increased by 1 if the counter input (CU) value changes from 0 -> 1 and the reset input (R) value is 0.

The counter output (CV) value is decreased by 1 if the counter input (CD) value changes from 0 -> 1 and the load input (LD) value is 0.

If the counter output has reached its minimum or maximum value, -2147483648 or +2147483647, the counter output remains unchanged until it is reset (R) or until the load input (LD) is set.

If the load input (LD) value is 1, the preset input (PV) value is stored as the counter output (CV) value.

The counter output (CV) is reset to 0 if the reset input (R) is 1.

The up counter status output (QU) is 1 if the counter output (CV) value $\geq$ preset input (PV) value.

The down counter status output (QD) is 1 if the counter output (CV) value $\leq$ 0.

Example:

CU	CD	R	LD	PV	QU	QD	CV_{prev}	CV
0 -> 0	0 -> 0	0	0	2	0	1	0	0
0 -> 0	0 -> 0	0	1	2	1	0	0	2
0 -> 0	0 -> 0	1	0	2	0	1	2	0
0 -> 0	0 -> 0	1	1	2	0	1	0	0
0 -> 0	0 -> 1	0	0	2	0	1	0	0 - 1 = -1
0 -> 0	1 -> 1	0	1	2	1	0	-1	2
0 -> 0	1 -> 1	1	0	2	0	1	2	0
0 -> 0	1 -> 1	1	1	2	0	1	0	0
0 -> 1	1 -> 0	0	0	2	0	0	0	0 + 1 = 1
1 -> 1	0 -> 0	0	1	2	1	0	1	2
1 -> 1	0 -> 0	1	0	2	0	1	2	0
1 -> 1	0 -> 0	1	1	2	0	1	0	0
1 -> 1	0 -> 1	0	0	2	0	1	0	0 - 1 = -1
1 -> 1	1 -> 1	0	1	2	1	0	-1	2
1 -> 1	1 -> 1	1	0	2	0	1	2	0
1 -> 1	1 -> 1	1	1	2	0	1	0	0
CV_{prev} is the previous cycle counter output value.								

Inputs Down counter input (CD): Boolean
Up counter input (CU): Boolean
Load input (LD): Boolean
Reset input (R): Boolean
Preset input (PV): DINT

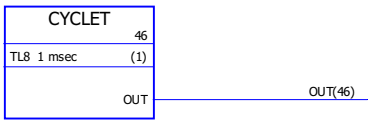
Outputs Down counter status output (QD): Boolean
Up counter status output (QU): Boolean
Counter output (CV): DINT

CYCLET

(10074)

Type Feedback & algorithms

Illustration



Execution time 0.00 µs

Operation Output (OUT) is the execution time of the selected function block.

Inputs -

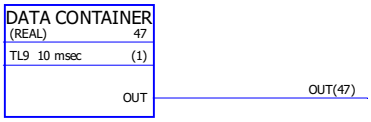
Outputs Output (OUT): DINT. 1 = 1 µs

DATA CONTAINER

(10073)

Type Data container

Illustration



Execution time 0.00 µs

Operation Output (OUT) is the array data used by the XTAB and YTAB tables in block *FUNG-1V* (on page *251*). Note that the array is defined with the output pin.

Inputs -

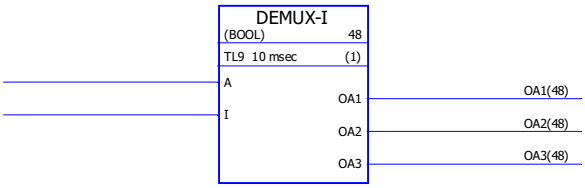
Outputs The output data type and the number of coordinate pairs are selected by the user.
Output (OUT): DINT, INT, REAL or REAL24

DEMUX-I

(10061)

Type Switch & demux

Illustration



Execution time 1.38 µs (when two inputs are used) + 0.30 µs (for every additional input). When all inputs are used, the execution time is 10.38 µs.

Operation Input (I) value is stored to the output (OA1…OA32) selected by the address input (A). All other outputs are 0.

If the address input is 0, negative or exceeds the number of the outputs, all outputs are 0.

Inputs The input data type is selected by the user.

Address input (A): DINT

Input (I): INT, DINT, Boolean, REAL, REAL24

Outputs The number of the output channels (2…32) is selected by the user.

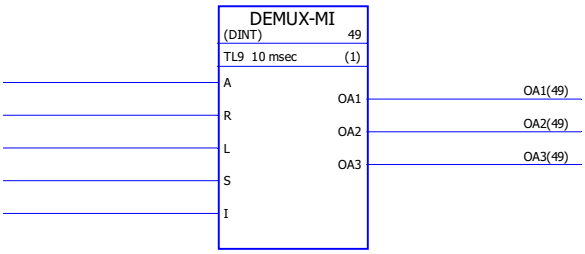
Output (OA1…OA32): INT, DINT, REAL, REAL24, Boolean

DEMUX-MI

(10062)

Type Switch & demux

Illustration



Execution time 0.99 µs (when two inputs are used) + 0.25 µs (for every additional input). When all inputs are used, the execution time is 8.4 µs.

Operation The input (I) value is stored to the output (OA1…OA32) selected by the address input (A) if the load input (L) or the set input (S) is 1. When the load input is set to 1, the input (I) value is stored to the output only once. When the set input is set to 1, the input (I) value is stored to the output every time the block is executed. The set input overrides the load input.

If the reset input (R) is 1, all connected outputs are 0.

If the address input is 0, negative or exceeds the number of the outputs, all outputs are 0.

Example:

S	L	R	A	I	OA1	OA2	OA3	OA4
1	0	0	2	150	0	150	0	0
0	0	0	2	120	0	150	0	0
0	1	0	3	100	0	150	100	0
1	0	0	1	200	200	150	100	0
1	1	0	4	250	200	150	100	250
1	1	1	2	300	0	0	0	0

Inputs The input data type is selected by the user.

Set input (S): Boolean

Load input (L): Boolean

Reset input (R): Boolean

Address input (A): DINT

Input (I): DINT, INT, REAL, REAL24, Boolean

Outputs The number of the output channels (2…32) is selected by the user.

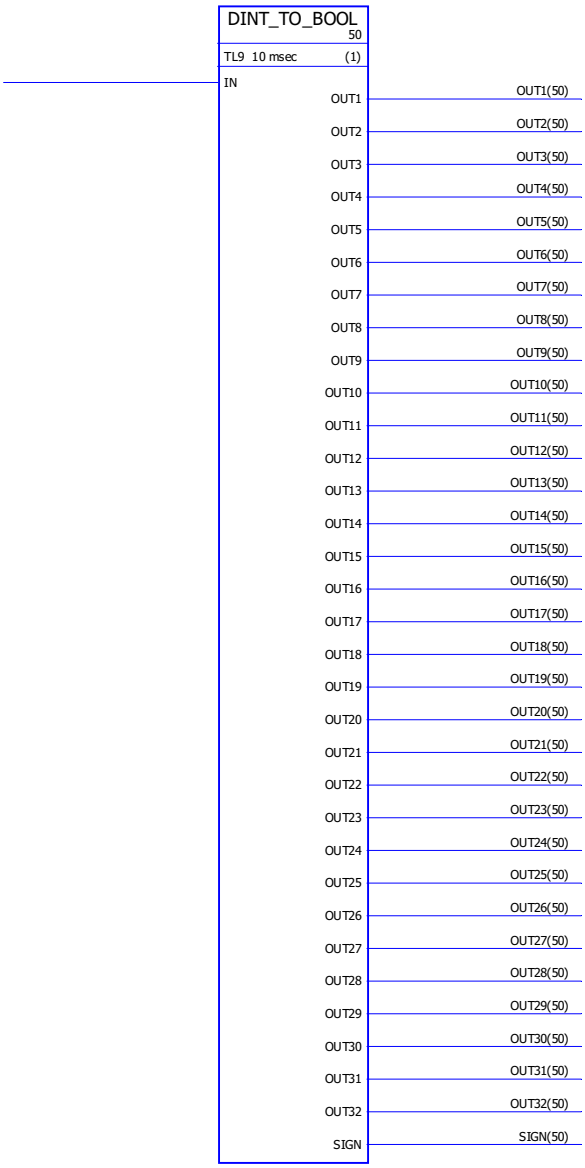
Output (OA1…OA32): DINT, INT, REAL, REAL24, Boolean

DINT_TO_BOOL

(10020)

Type Conversion

Illustration



Execution time 11.98 µs

Operation The boolean output (OUT1…32) values are formed from the 32-bit integer input (IN) value.

Example:

IN = 0 111 1111 1111 1111 1111 1111 1111 1100

SIGN — OUT32…OUT1

Inputs Input (IN): DINT

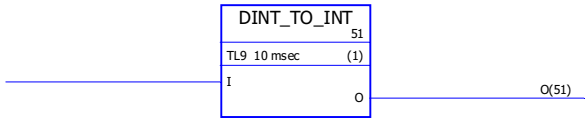
Outputs Output (OUT1…OUT32): Boolean
Sign output (SIGN): Boolean

DINT_TO_INT

(10021)

Type Conversion

Illustration



Execution time 0.53 µs

Operation The output (O) value is a 16-bit integer value of the 32-bit integer input (I) value.
Examples:

I (31 bits + sign)	**O** (15 bits + sign)
2147483647	32767
-2147483648	-32767
0	0

Inputs Input (I): DINT

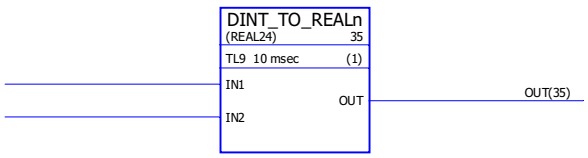
Outputs Output (O): INT

DINT_TO_REALn

(10023)

Type Conversion

Illustration



Execution time 7.25 µs

Operation The output (OUT) is the REAL/REAL24 equivalent of the input (IN). Input IN1 is the integer value and input IN2 is the fractional value.
If one (or both) of the input values is negative, the output value is negative.
Example (from DINT to REAL):
When IN1 = 2 and IN2 = 3276, OUT = 2.04999.
The output value is limited to the maximum value of the selected data type range.

Inputs Input (IN1, IN2): DINT

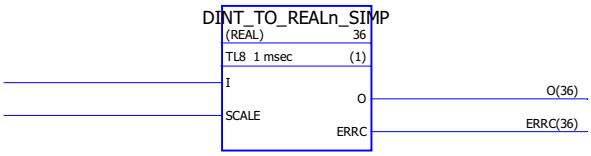
Outputs The output data type is selected by the user.
Output (OUT): REAL, REAL24

DINT_TO_REALn_SIMP

(10022)

Type Conversion

Illustration



Execution time 6.53 µs

Operation The output (O) is the REAL/REAL24 equivalent of the input (I) divided by the scale input (SCALE).

Error codes indicated at the error output (ERRC) are as follows:

Error code	Description
0	No error
1001	The calculated REAL/REAL24 value exceeds the minimum value of the selected data type range. The output is set to the minimum value.
1002	The calculated REAL/REAL24 value exceeds the maximum value of the selected data type range. The output is set to the maximum value.
1003	The SCALE input is 0. The output is set to 0.
1004	Incorrect SCALE input, i.e. the scale input is < 0 or is not a factor of 10.

Example (from DINT to REAL24):

When I = 205 and SCALE = 100, I/SCALE = 205 /100 = 2.05 and O = 2.04999.

Inputs Input (I): DINT

Scale input (SCALE): DINT

Outputs The output data type is selected by the user.

Output (O): REAL, REAL24

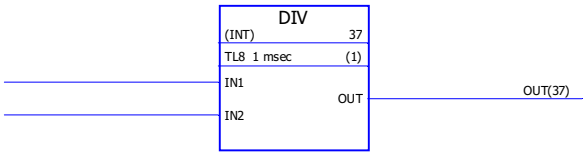
Error output (ERRC): DINT

DIV

(10002)

Type Arithmetic

Illustration



Execution time 2.55 µs

Operation The output (OUT) is input IN1 divided by input IN2.

OUT = IN1/IN2

The output value is limited to the maximum and minimum values defined by the selected data type range.

If the divider (IN2) is 0, the output is 0.

Inputs The input data type is selected by the user.

Input (IN1, IN2): INT, DINT, REAL, REAL24

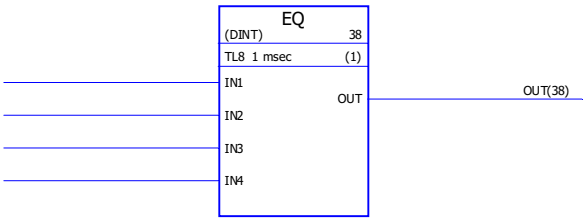
Outputs Output (OUT): INT, DINT, REAL, REAL24

EQ

(10040)

Type Comparison

Illustration



Execution time 0.89 µs (when two inputs are used) + 0.43 µs (for every additional input). When all inputs are used, the execution time is 13.87 µs.

Operation The output (OUT) is 1 if all the connected input values are equal (IN1 = IN2 = … = IN32). Otherwise the output is 0.

Inputs The input data type and the number of inputs (2…32) are selected by the user.

Input (IN1…IN32): INT, DINT, REAL, REAL24

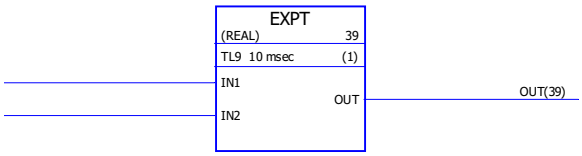
Outputs Output (OUT): Boolean

EXPT

(10003)

Type Arithmetic

Illustration



Execution time 81.90 µs

Operation The output (OUT) is input IN1 raised to the power of the input IN2:

$OUT = IN1^{IN2}$

If input IN1 is 0, the output is 0.

The output value is limited to the maximum value defined by the selected data type range.

Note: The execution of the EXPT function is slow.

Inputs The input data type is selected by the user.

Input (IN1): REAL, REAL24

Input (IN2): REAL

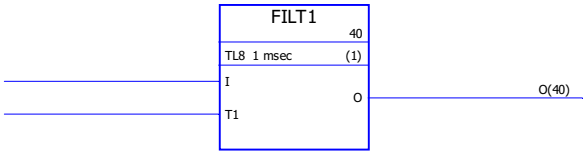
Outputs Output (OUT): REAL, REAL24

FILT1

(10069)

Type Filter

Illustration



Execution time 7.59 µs

Operation The output (O) is the filtered value of the input (I) value and the previous output value (O_{prev}). The FILT1 block acts as 1st order low pass filter.

Note: Filter time constant (T1) must be selected so that T1/Ts < 32767. If the ratio exceeds 32767, it is considered as 32767. Ts is the cycle time of the program in ms.

If T1 < Ts, the output value is the input value.

The step response for a single pole low pass filter is:

$O(t) = I(t) \times (1 - e^{-t/T1})$

The transfer function for a single pole low pass filter is:

$G(s) = 1/ (1 + sT1)$

Inputs Input (I): REAL

Filter time constant input (T1): DINT, 1 = 1 ms

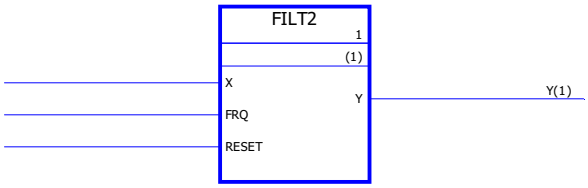
Outputs Output (O): REAL

FILT2

(10070)

Type Filter

Illustration



Execution time 6.30 µs

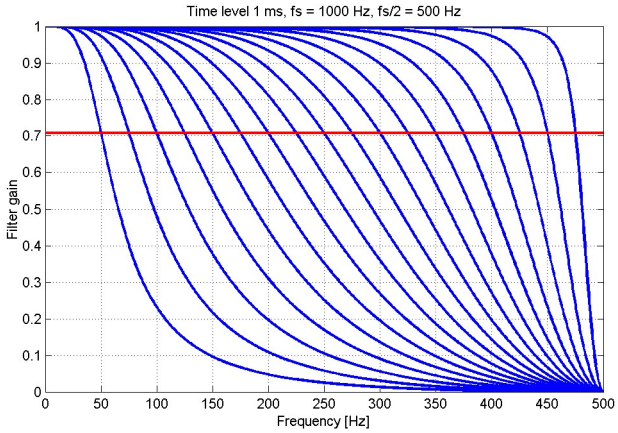
Operation The output (Y) is the filtered value of the input (X). The FILT2 block acts as a 2nd order low pass filter.

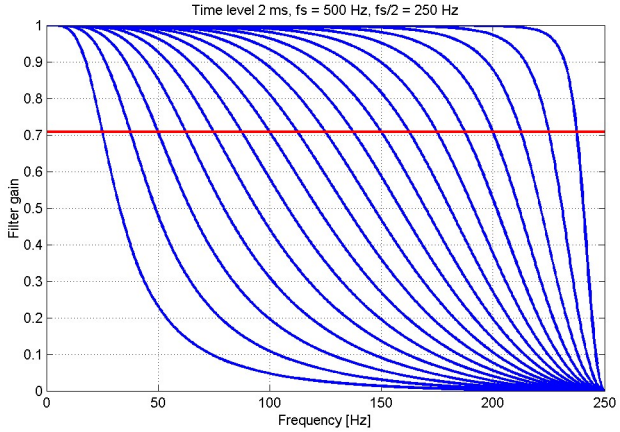
When the RESET input value is set to 1, the input is connected to the output without filtering.

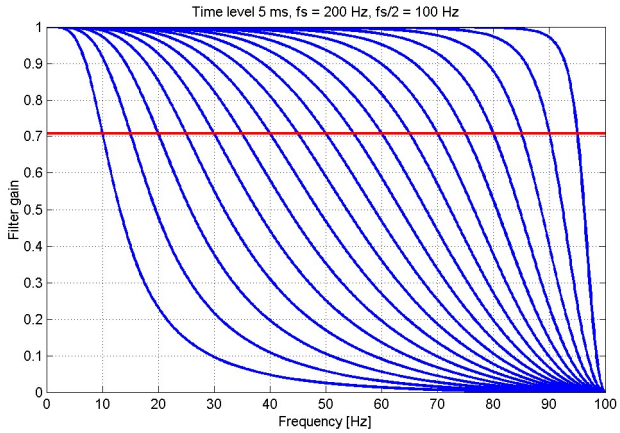
Notes:

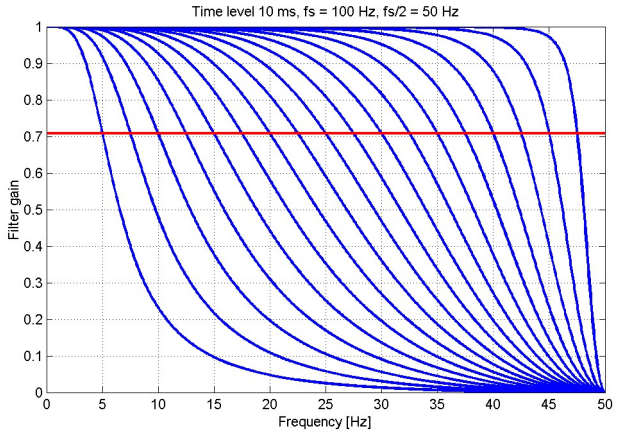
- The -3 dB cutoff frequency (FRQ) is limited to its maximum value (16383 Hz).
- The frequency of the input signal must be less than half of sampling frequency (fs) – any higher frequencies are aliased to the allowable range. The sampling frequency is defined by the time level of the block; for example, 1 ms corresponds to a sampling frequency of 1000 Hz.

The following diagrams show the frequency responses for 1, 2, 5 and 10 ms time levels. The -3 dB cutoff level is represented as the horizontal line at 0.7 gain.









Inputs Input (X): REAL
-3 dB cutoff frequency input (FRQ): DINT (0…16383 Hz)
Reset input (RESET): Boolean

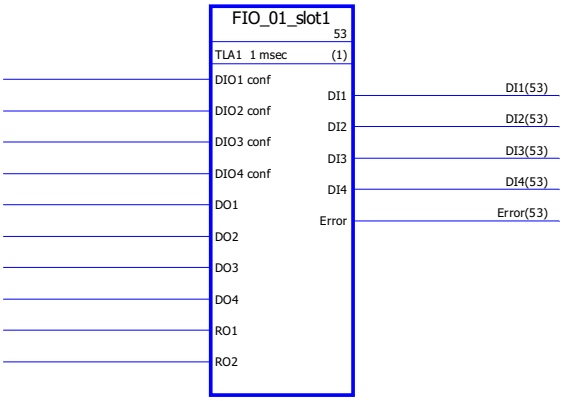
Outputs Output (Y): REAL

FIO_01_slot1

(10084)

Type Extensions

Illustration



Execution time 8.6 µs

Operation The block controls the four digital inputs/outputs (DIO1…DIO4) and two relay outputs (RO1, RO2) of a FIO-01 Digital I/O Extension mounted on slot 1 of the drive control unit.

The state of a DIOx conf input of the block determines whether the corresponding DIO on the FIO-01 is an input or an output (0 = input, 1 = output). If the DIO is an output, the DOx input of the block defines its state.

The RO1 and RO2 inputs define the state of the relay outputs of the FIO-01 (0 = not energised, 1 = energised).

The DIx outputs show the state of the DIOs.

Inputs Digital input/output mode selection (DIO1 conf … DIO4 conf): Boolean

Digital output state selection (DO1…DO4): Boolean

Relay output state selection (RO1, RO2): Boolean

Outputs Digital input/output state (DI1…DI4): Boolean

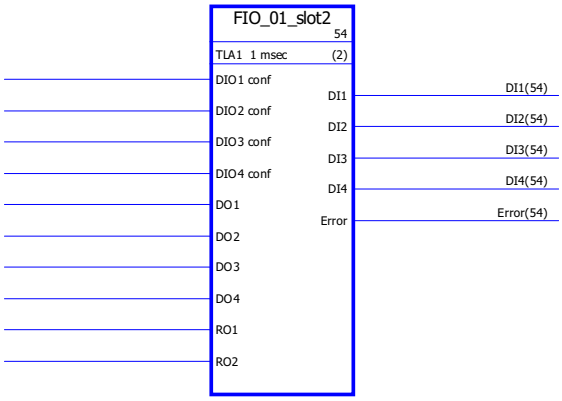
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FIO_01_slot2

(10085)

Type Extensions

Illustration



Execution time 8.6 µs

Operation The block controls the four digital inputs/outputs (DIO1…DIO4) and two relay outputs (RO1, RO2) of a FIO-01 Digital I/O Extension mounted on slot 2 of the drive control unit.

The state of a DIOx conf input of the block determines whether the corresponding DIO on the FIO-01 is an input or an output (0 = input, 1 = output). If the DIO is an output, the DOx input of the block defines its state.

The RO1 and RO2 inputs define the state of the relay outputs of the FIO-01 (0 = not energised, 1 = energised).

The DIx outputs show the state of the DIOs.

Inputs Digital input/output mode selection (DIO1 conf … DIO4 conf): Boolean

Digital output state selection (DO1…DO4): Boolean

Relay output state selection (RO1, RO2): Boolean

Outputs Digital input/output state (DI1…DI4): Boolean

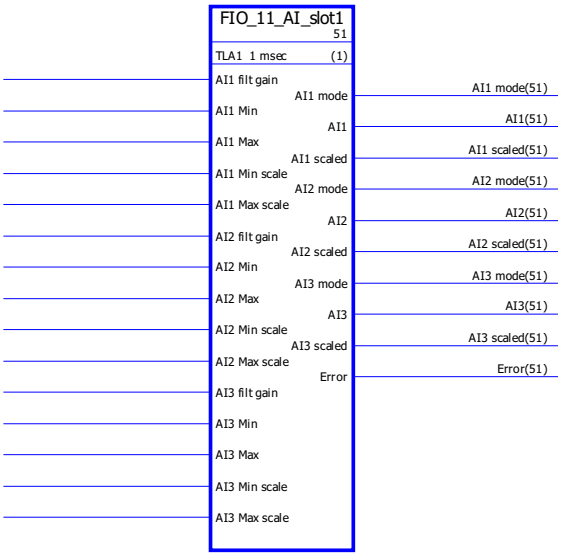
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FIO_11_AI_slot1

(10088)

Type Extensions

Illustration



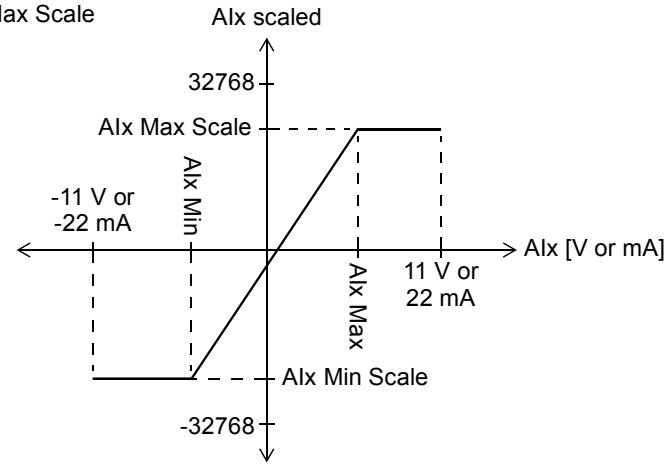
Execution time 11.1 µs

Operation The block controls the three analogue inputs (AI1…AI3) of a FIO-11 Analog I/O Extension mounted on slot 1 of the drive control unit.

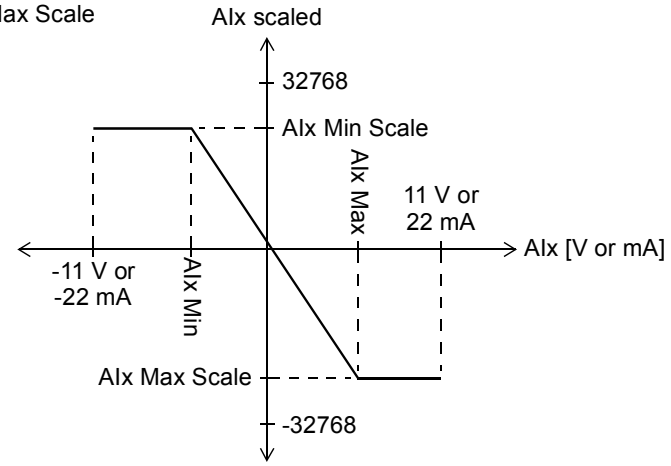
The block outputs both the unscaled (AIx) and scaled (AIx scaled) actual values of each analogue input. The scaling is based on the relationship between the ranges AIx min … AIx max and AIx min scale … AIx max scale.

AIx Min must be smaller than AIx Max; AIx Max Scale can be greater or smaller than AIx Min Scale.

AIx Min Scale < AIx Max Scale



AIx Min Scale > AIx Max Scale



The AIx filt gain inputs determine a filtering time for each input as follows:

AIx filt gain	Filtering time	Notes
0	No filtering	
1	125 µs	Recommended setting
2	250 µs	
3	500 µs	
4	1 ms	
5	2 ms	
6	4 ms	
7	7.9375 ms	

The AIx mode outputs show whether the corresponding input is voltage (0) or current (1). The voltage/current selection is made using the hardware switches on the FIO-11.

Inputs

Analogue input filter gain selection (AI1 filt gain … AI3 filt gain): INT
Minimum value of input signal (AI1 Min … AI3 Min): REAL (≥ -11 V or -22 mA)
Maximum value of input signal (AI1 Max … AI3 Max): REAL (≤ 11 V or 22 mA)
Minimum value of scaled output signal (AI1 Min scale … AI3 Min scale): REAL
Maximum value of scaled output signal (AI1 Max scale … AI3 Max scale): REAL

Outputs

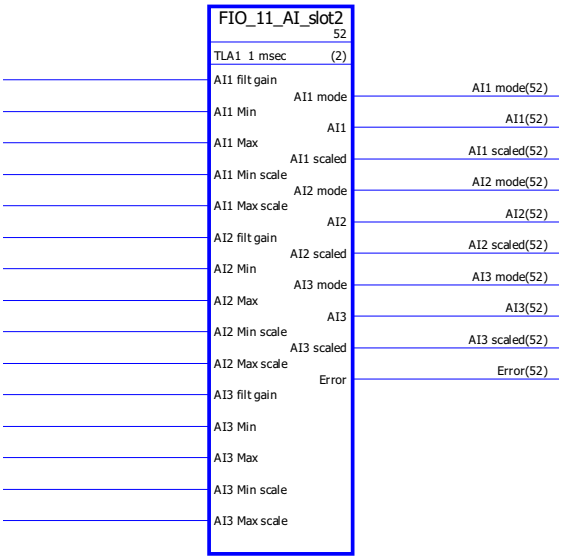
Analogue input mode (voltage or current) (AI1 mode … AI3 mode): Boolean
Value of analogue input (AI1 … AI3): REAL
Scaled value of analogue input (AI1 scaled … AI3 scaled): REAL
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FIO_11_AI_slot2

(10089)

Type Extensions

Illustration



Execution time 11.1 µs

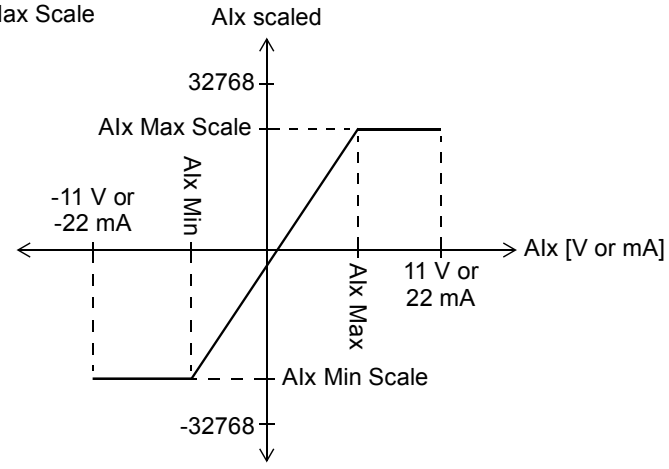
Operation

The block controls the three analogue inputs (AI1…AI3) of a FIO-11 Analog I/O Extension mounted on slot 2 of the drive control unit.

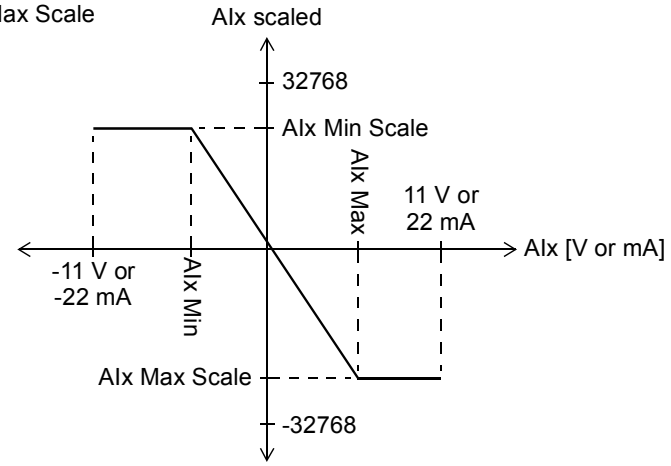
The block outputs both the unscaled (AIx) and scaled (AIx scaled) actual values of each analogue input. The scaling is based on the relationship between the ranges AIx min … AIx max and AIx min scale … AIx max scale.

AIx Min must be smaller than AIx Max; AIx Max Scale can be greater or smaller than AIx Min Scale.

AIx Min Scale < AIx Max Scale



AIx Min Scale > AIx Max Scale



The AIx filt gain inputs determine a filtering time for each input as follows:

AIx filt gain	Filtering time	Notes
0	No filtering	
1	125 µs	Recommended setting
2	250 µs	
3	500 µs	
4	1 ms	
5	2 ms	
6	4 ms	
7	7.9375 ms	

The AIx mode outputs show whether the corresponding input is voltage (0) or current (1). The voltage/current selection is made using the hardware switches on the FIO-11.

Inputs

Analogue input filter gain selection (AI1 filt gain … AI3 filt gain): INT
Minimum value of input signal (AI1 Min … AI3 Min): REAL (≥ -11 V or -22 mA)
Maximum value of input signal (AI1 Max … AI3 Max): REAL (≤ 11 V or 22 mA)
Minimum value of scaled output signal (AI1 Min scale … AI3 Min scale): REAL
Maximum value of scaled output signal (AI1 Max scale … AI3 Max scale): REAL

Outputs

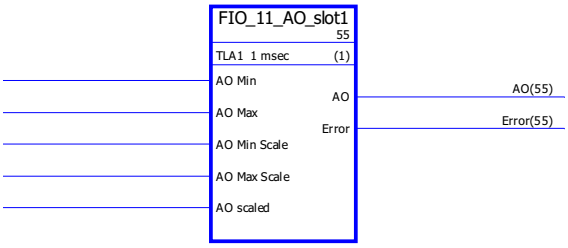
Analogue input mode (voltage or current) (AI1 mode … AI3 mode): Boolean
Value of analogue input (AI1 … AI3): REAL
Scaled value of analogue input (AI1 scaled … AI3 scaled): REAL
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FIO_11_AO_slot1

(10090)

Type Extensions

Illustration



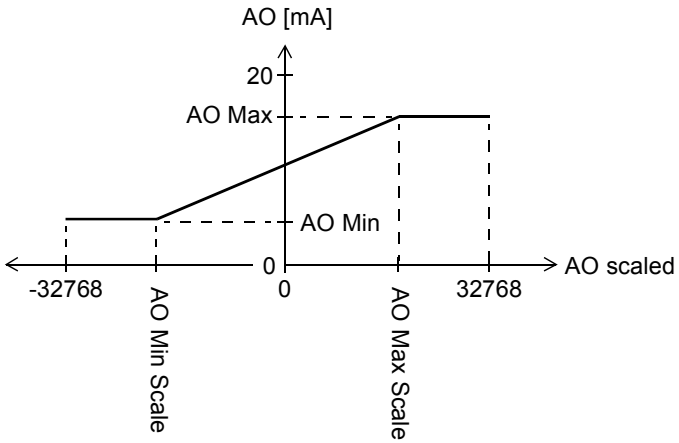
Execution time 4.9 µs

Operation The block controls the analogue output (AO1) of a FIO-11 Analog I/O Extension mounted on slot 1 of the drive control unit.

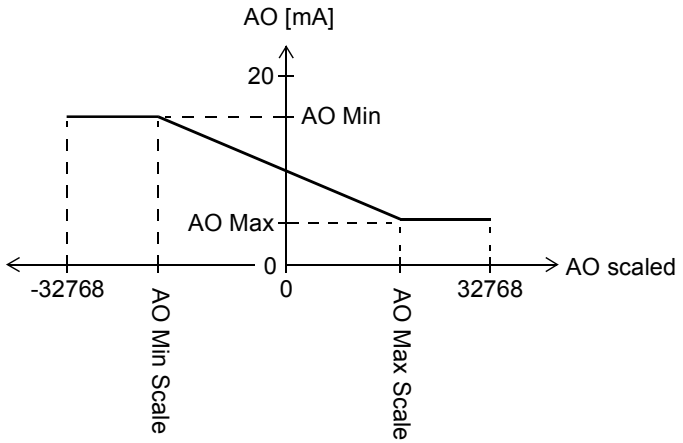
The block converts the input signal (AO scaled) to a 0…20 mA signal (AO) that drives the analogue output; the input range AO Min Scale … AO Max Scale corresponds to the current signal range of AO Min … AO Max.

AO Min Scale must be smaller than AO Max Scale; AO Max can be greater or smaller than AO Min.

AO Min < AO Max



AO Min > AO Max



Inputs
Minimum current signal (AO Min): REAL (0…20 mA)
Maximum current signal (AO Max): REAL (0…20 mA)
Minimum input signal (AO Min Scale): REAL
Maximum input signal (AO Max Scale): REAL
Input signal (AO scaled): REAL

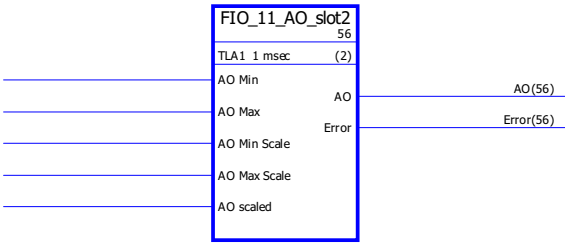
Outputs
Analogue output current value (AO): REAL
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FIO_11_AO_slot2

(10091)

Type Extensions

Illustration



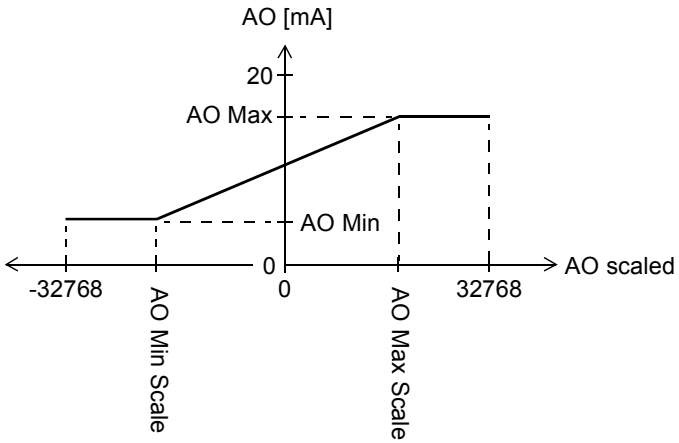
Execution time 4.9 µs

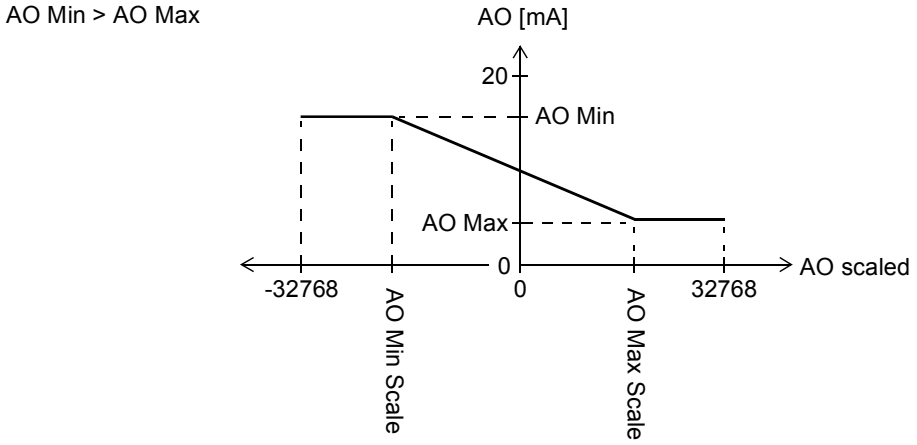
Operation The block controls the analogue output (AO1) of a FIO-11 Analog I/O Extension mounted on slot 2 of the drive control unit.

The block converts the input signal (AO scaled) to a 0…20 mA signal (AO) that drives the analogue output; the input range AO Min Scale … AO Max Scale corresponds to the current signal range of AO Min … AO Max.

AO Min Scale must be smaller than AO Max Scale; AO Max can be greater or smaller than AO Min.

AO Min < AO Max





Inputs
Minimum current signal (AO Min): REAL (0…20 mA)
Maximum current signal (AO Max): REAL (0…20 mA)
Minimum input signal (AO Min Scale): REAL
Maximum input signal (AO Max Scale): REAL
Input signal (AO scaled): REAL

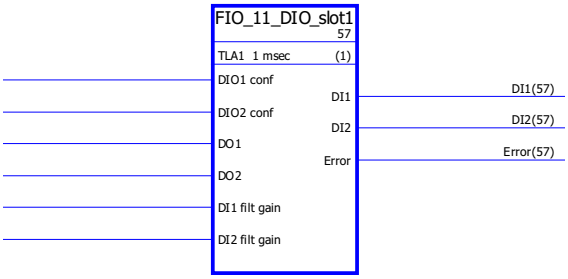
Outputs
Analogue output current value (AO): REAL
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FIO_11_DIO_slot1

(10086)

Type Extensions

Illustration



Execution time 6.0 µs

Operation The block controls the two digital inputs/outputs (DIO1, DIO2) of a FIO-11 Digital I/O Extension mounted on slot 1 of the drive control unit.

The state of a DIOx conf input of the block determines whether the corresponding DIO on the FIO-11 is an input or an output (0 = input, 1 = output). If the DIO is an output, the DOx input of the block defines its state.

The DIx outputs show the state of the DIOs.

The DIx filt gain inputs determine a filtering time for each input as follows:

DIx filt gain	Filtering time
0	7.5 µs
1	195 µs
2	780 µs
3	4.680 ms

Inputs Digital input/output mode selection (DIO1 conf, DIO2 conf): Boolean

Digital output state selection (DO1, DO2): Boolean

Digital input filter gain selection (DI1 filt gain, DI2 filt gain): INT

Outputs Digital input/output state (DI1, DI2): Boolean

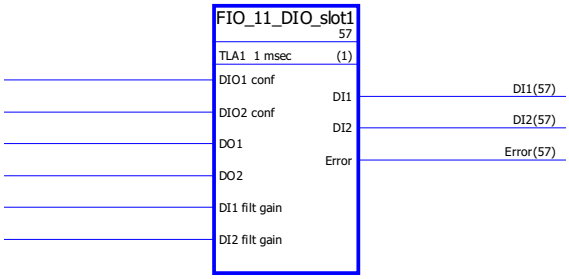
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FIO_11_DIO_slot2

(10087)

Type Extensions

Illustration



Execution time 6.0 µs

Operation The block controls the two digital inputs/outputs (DIO1, DIO2) of a FIO-11 Digital I/O Extension mounted on slot 2 of the drive control unit.

The state of a DIOx conf input of the block determines whether the corresponding DIO on the FIO-11 is an input or an output (0 = input, 1 = output). If the DIO is an output, the DOx input of the block defines its state.

The DIx outputs show the state of the DIOs.

The DIx filt gain inputs determine a filtering time for each input as follows:

DIx filt gain	Filtering time
0	7.5 µs
1	195 µs
2	780 µs
3	4.680 ms

Inputs Digital input/output mode selection (DIO1 conf, DIO2 conf): Boolean

Digital output state selection (DO1, DO2): Boolean

Digital input filter gain selection (DI1 filt gain, DI2 filt gain): INT

Outputs Digital input/output state (DI1, DI2): Boolean

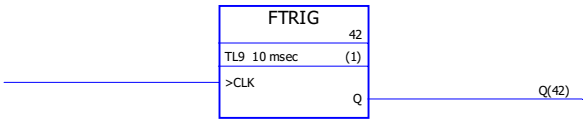
Error output (Error): DINT (0 = No error; 1 = Solution program memory full)

FTRIG

(10030)

Type Edge & bistable

Illustration



Execution time 0.38 µs

Operation The output (Q) is set to 1 when the clock input (CLK) changes from 1 to 0. The output is set back to 0 with the next execution of the block. Otherwise the output is 0.

$CLK_{previous}$	**CLK**	**Q**
0	0	0
0	1	0
1	0	1 (for one execution cycle time, returns to 0 at the next execution)
1	1	0
$CLK_{previous}$ is the previous cycle output value.		

Note: The output (Q) is 0 after cold restart and after the first execution of the block. Otherwise the output is 1, when the clock input (CLK) is 1.

Inputs Clock input (CLK): Boolean

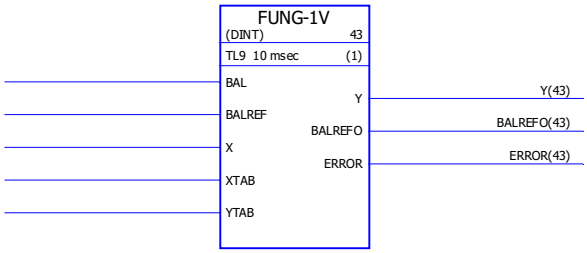
Outputs Output (Q): Boolean

FUNG-1V

(10072)

Type Data container

Illustration



Execution time 9.29 µs

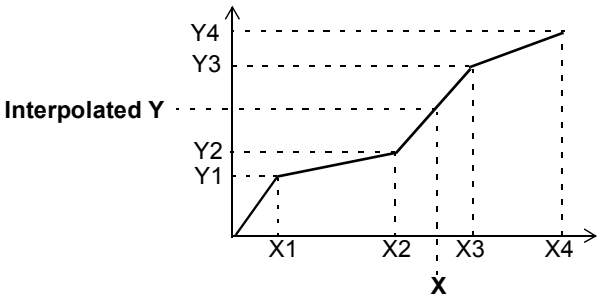
Operation

The output (Y) at the value of the input (X) is calculated with linear interpolation from a piecewise linear function.

$Y = Y_k + (X - X_k)(Y_{k+1} - Y_k) / (X_{k+1} - X_k)$

The piecewise linear function is defined by the X and Y vector tables (XTAB and YTAB). For each X-value in the XTAB table, there is a corresponding Y-value in the YTAB table. The values in XTAB and YTAB must be in ascending order (i.e. from low to high).

XTAB and YTAB values are defined with the SPC tool (SPC = Solution Program Composer).



X table (XTAB)	Y table (YTAB)
X1	Y1
X2	Y2
X3	Y3
…	…
X9	Y9

The balancing function (BAL) permits the output signal to track an external reference and gives a smooth return to the normal operation. If BAL is set to 1, output Y is set to the value of the balance reference input (BALREF). The X value which corresponds to this Y value is calculated with linear interpolation and it is indicated by the balance reference output (BALREFO).

If the X input is outside the range defined by the XTAB table, the output Y is set to the highest or lowest value in the YTAB table and the ERROR output is set to 1.

If BALREF is outside the range defined by the YTAB table when balancing is activated (BAL: 0 -> 1), the output Y is set to the value of the BALREF input and BALREFO output is set to the highest or lowest value in the XTAB table. (ERROR output is 0).

ERROR output is set to 1 when the number of the XTAB and YTAB inputs are different. When ERROR is 1, the FUNG-1V block will not function. XTAB and YTAB tables are defined in the *DATA CONTAINER* block (on page *229*).

Inputs

The input data type is selected by the user.

X value input (X): DINT, INT, REAL, REAL24

Balance input (BAL): Boolean

Balance reference input (BALREF): DINT, INT, REAL, REAL24.

X table input (XTAB): DINT, INT, REAL, REAL24

Y table input (YTAB): DINT, INT, REAL, REAL24

Outputs

Y value output (Y): DINT, INT, REAL, REAL24

Balance reference output (BALREFO): DINT, INT, REAL, REAL24

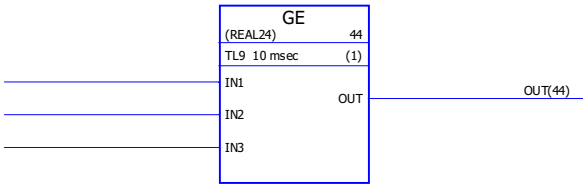
Error output (ERROR): Boolean

GE >=

(10041)

Type Comparison

Illustration



Execution time 0.89 µs (when two inputs are used) + 0.43 µs (for every additional input). When all inputs are used, the execution time is 13.87 µs.

Operation The output (OUT) is 1 if (IN1 ≥ IN2) & (IN2 ≥ IN3) & … & (IN31 ≥ IN32). Otherwise the output is 0.

Inputs The input data type and the number of inputs (2…32) are selected by the user.
Input (IN1…IN32): INT, DINT, REAL, REAL24

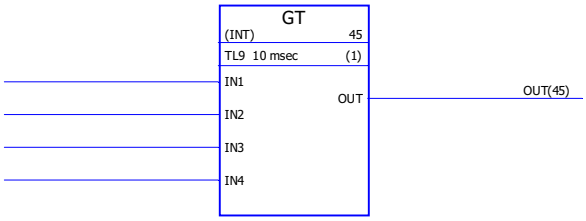
Outputs Output (OUT): Boolean

GT >

(10042)

Type Comparison

Illustration



Execution time 0.89 µs (when two inputs are used) + 0.43 µs (for every additional input). When all inputs are used, the execution time is 13.87 µs.

Operation The output (OUT) is 1 if (IN1 > IN2) & (IN2 > IN3) & … & (IN31 > IN32). Otherwise the output is 0.

Inputs The input data type and the number of inputs (2…32) are selected by the user.
Input (IN1…IN32): INT, DINT, REAL, REAL24

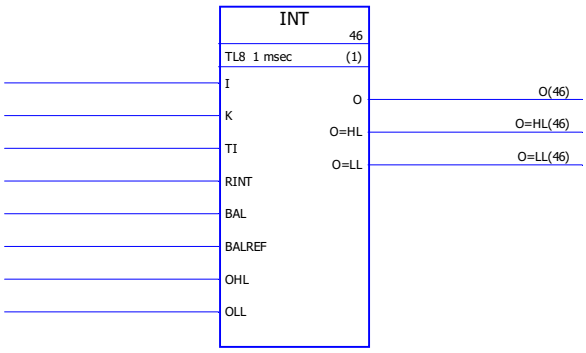
Outputs Output (OUT): Boolean

INT

(10065)

Type Feedback & algorithms

Illustration



Execution time 4.73 µs

Operation The output (O) is the integrated value of the input (I):

$O(t) = K/TI (\int I(t)\, dt)$

Where TI is the integration time constant and K is the integration gain.

The step response for the integration is:

$O(t) = K \times I(t) \times t/TI$

The transfer function for the integration is:

$G(s) = K\ 1/sTI$

The output value is limited according to the defined minimum and maximum limits (OLL and OHL). If the value is below the minimum value, output O = LL is set to 1. If the value exceeds the maximum value, output O = HL is set to 1. The output (O) retains its value when the input signal I(t) = 0.

The integration time constant is limited to value 2147483 ms. If the time constant is negative, zero time constant is used.

If the ratio between the cycle time and the integration time constant Ts/TI < 1, Ts/TI is set to 1.

The integrator is cleared when the reset input (RINT) is set to 1.

If BAL is set to 1, output O is set to the value of the input BALREF. When BAL is set back to 0, normal integration operation continues.

Inputs Input (I): REAL

Gain input (K): REAL

Integration time constant input (TI): DINT, 0…2147483 ms

Integrator reset input (RINT): Boolean

Balance input (BAL): Boolean

Balance reference input (BALREF): REAL

Output high limit input (OHL): REAL

Output low limit input (OLL): REAL

Outputs Output (O): REAL

High limit output (O=HL): Boolean

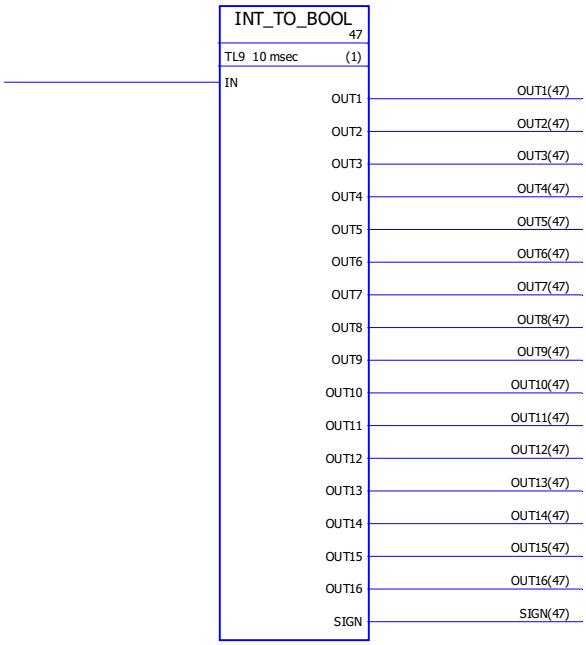
Low limit output (O=LL): Boolean

INT_TO_BOOL

(10024)

Type Conversion

Illustration



Execution time 4.31 µs

Operation The boolean output (OUT1…16) values are formed from the 16-bit integer input (IN) value.

Example:

IN = 0111 1111 1111 1111

SIGN OUT16…OUT1

Inputs Input (IN): INT

Outputs Output (OUT1…OUT16): Boolean

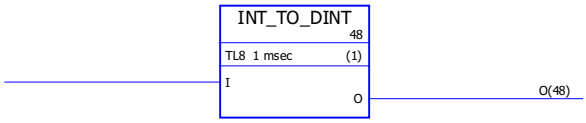
Sign output (SIGN): Boolean

INT_TO_DINT

(10025)

Type Conversion

Illustration



Execution time 0.33 µs

Operation The output (O) value is a 32-bit integer value of the 16-bit integer input (I) value.

I	O
32767	32767
-32767	-32767
0	0

Inputs Input (I): INT

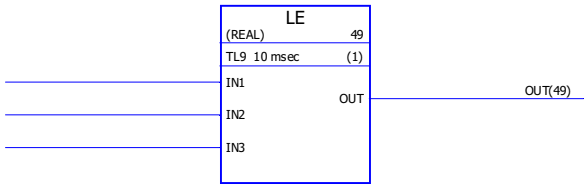
Outputs Output (O): DINT

LE <=

(10043)

Type Comparison

Illustration



Execution time 0.89 µs (when two inputs are used) + 0.43 µs (for every additional input). When all inputs are used, the execution time is 13.87 µs.

Operation Output (OUT) is 1 if (IN1 ≤ IN2) & (IN2 ≤ IN3) & … & (IN31 ≤ IN2). Otherwise the output is 0.

Inputs The input data type and the number of inputs (2…32) are selected by the user.
Input (IN1…IN32): INT, DINT, REAL, REAL24

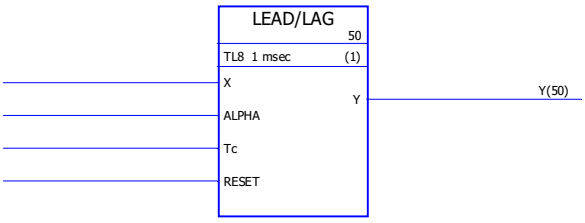
Outputs Output (OUT): Boolean

LEAD/LAG

(10071)

Type Filter

Illustration



Execution time 5.55 µs

Operation The output (Y) is the filtered value of the input (X). When ALPHA > 1, the function block acts as a lead filter. When ALPHA < 1, the function block acts as a lag filter. When ALPHA = 1, no filtering occurs.

The transfer function for a lead/lag filter is:

$(1 + \text{ALPHA}T_c s) / (1 + T_c s)$

When RESET input is 1, the input value (X) is connected to the output (Y).

If ALPHA or Tc < 0, the negative input value is set to zero before filtering.

Inputs Input (X): REAL

Lead/Lag filter type input (ALPHA): REAL

Time constant input (Tc): REAL

Reset input (RESET): Boolean

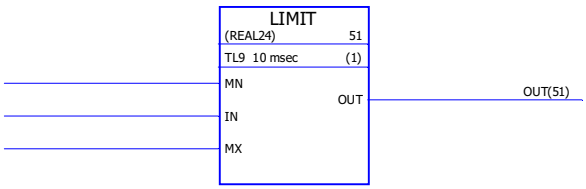
Outputs Output (Y): REAL

LIMIT

(10052)

Type Selection

Illustration



Execution time 0.53 µs

Operation The output (OUT) is the limited input (IN) value. Input is limited according to the minimum (MN) and maximum (MX) values.

Inputs The input data type is selected by the user.

Maximum input limit (MX): INT, DINT, REAL, REAL24

Minimum input limit (MN): INT, DINT, REAL, REAL24

Input (IN): INT, DINT, REAL, REAL24

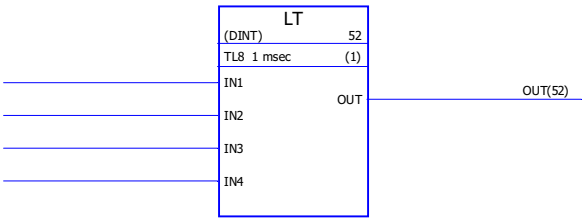
Outputs Output (OUT): INT, DINT, REAL, REAL24

LT <

(10044)

Type Comparison

Illustration



Execution time 0.89 µs (when two inputs are used) + 0.43 µs (for every additional input). When all inputs are used, the execution time is 13.87 µs.

Operation Output (OUT) is 1 if (IN1 < IN2) & (IN2 < IN3) & … & (IN31 < IN32). Otherwise the output is 0.

Inputs The input data type and the number of inputs (2…32) are selected by the user.
Input (IN1…IN32): INT, DINT, REAL, REAL24

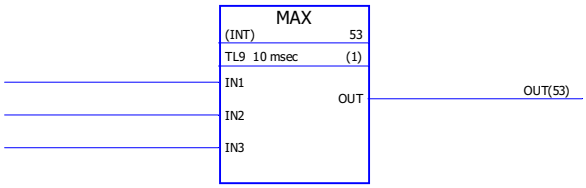
Outputs Output (OUT): Boolean

MAX

(10053)

Type Selection

Illustration



Execution time 0.81 µs (when two inputs are used) + 0.53 µs (for every additional input). When all inputs are used, the execution time is 16.73 µs.

Operation The output (OUT) is the highest input value (IN).

Inputs The input data type and the number of inputs (2…32) are selected by the user.
Input (IN1…IN32): INT, DINT, REAL, REAL24

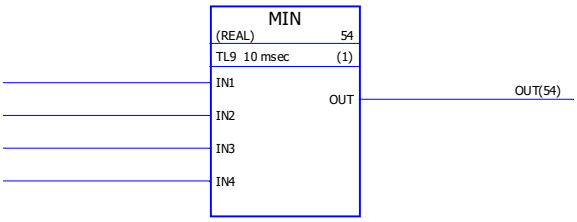
Outputs Output (OUT): INT, DINT, REAL, REAL24

MIN

(10054)

Type Selection

Illustration



Execution time 0.81 µs (when two inputs are used) + 0.52 µs (for every additional input). When all inputs are used, the execution time is 16.50 µs.

Operation The output (OUT) is the lowest input value (IN).

Inputs The input data type and the number of inputs (2…32) are selected by the user.
Input (IN1…IN32): INT, DINT, REAL, REAL24

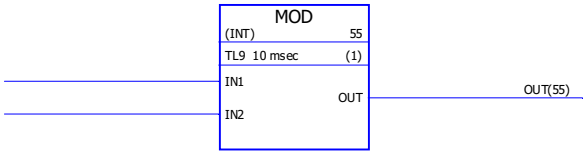
Outputs Output (OUT): INT, DINT, REAL, REAL24

MOD

(10004)

Type Arithmetic

Illustration



Execution time 1.67 µs

Operation The output (OUT) is the remainder of the division of the inputs IN1 and IN2.
OUT = remainder of IN1/IN2
If input IN2 is zero, the output is zero.

Inputs The input data type is selected by the user.
Input (IN1, IN2): INT, DINT

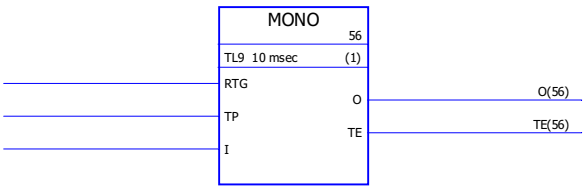
Outputs Output (OUT): INT, DINT

MONO

(10057)

Type Timer

Illustration



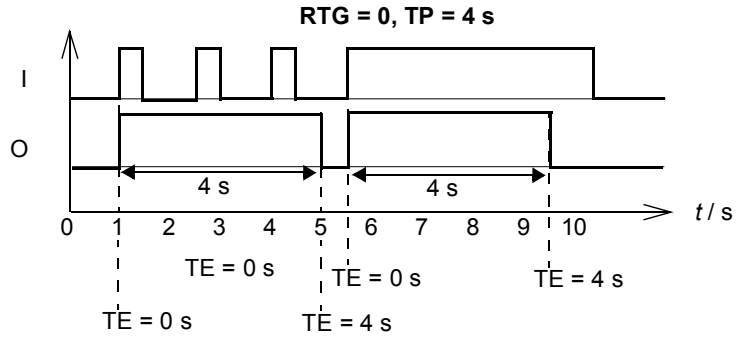
Execution time 1.46 µs

Operation The output (O) is set to 1 and the timer is started, if the input (I) is set to 1. The output is reset to 0 when the time defined by the time pulse input (TP) has elapsed. Elapsed time (TE) count starts when the output is set to 1 and stops when the output is set to 0.

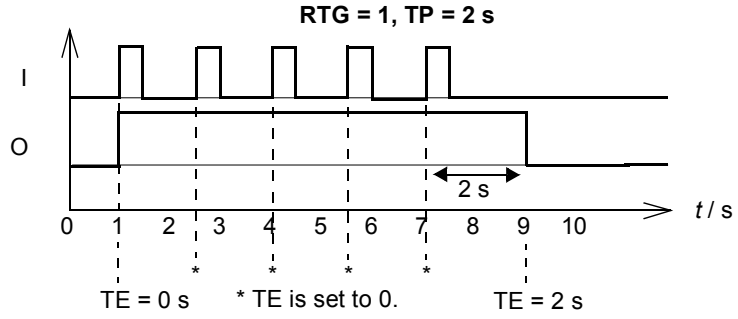
If RTG is 0, a new input pulse during the time defined by TP has no effect on the function. The function can be restarted only after the time defined by TP has elapsed.

If RTG is 1, a new input pulse during the time defined by TP restarts the timer and sets the elapsed time (TE) to 0.

Example 1: MONO is not re-triggable, i.e. RTG = 0.



Example 2: MONO is re-triggable, i.e. RTG = 1.



Inputs Re-trigger input (RTG): Boolean

Input (I): Boolean

Time pulse input (TP): DINT (1 = µs)

Outputs Output (O): Boolean

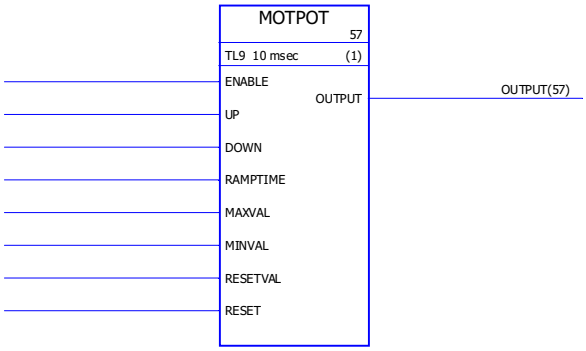
Time elapsed output (TE): DINT (1 = 1 µs)

MOTPOT

(10067)

Type Feedback & algorithms

Illustration



Execution time 2.92 µs

Operation The motor potentiometer function controls the rate of change of the output from the minimum to the maximum value and vice versa.

The function is enabled by setting the ENABLE input to 1. If the up input (UP) is 1, the output reference (OUTPUT) is increased to the maximum value (MAXVAL) with the defined ramp time (RAMPTIME). If the down input (DOWN) is 1, the output value is decreased to the minimum value (MINVAL) with the defined ramp time. If the up and down inputs are activated/deactivated simultaneously, the output value is not increased/decreased.

If the RESET input is 1, the output will be reset to the value defined by the reset value input (RESETVAL) or to the value defined by the minimum input (MINVAL), whichever is higher.

If the ENABLE input is 0, the output is zero.

During power recycle the previous values can be stored to the memory (storing must be activated by the user). **Note:** Memory storing is not supported yet.

Digital inputs are normally used as up and down inputs.

Inputs Function enable input (ENABLE): Boolean

Up input (UP): Boolean

Down input (DOWN): Boolean

Ramp time input (RAMPTIME): REAL (seconds) (i.e. the time required for the output to change from the minimum to the maximum value or from the maximum to the minimum value)

Maximum reference input (MAXVAL): REAL

Minimum reference input (MINVAL): REAL

Reset value input (RESETVAL): REAL

Reset input (RESET): Boolean

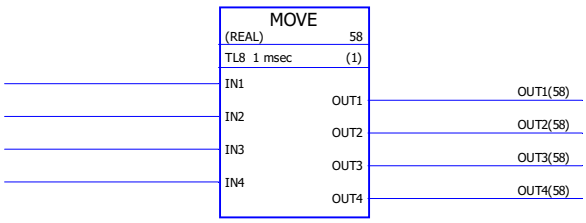
Outputs Output (OUTPUT) REAL

MOVE

(10005)

Type Arithmetic

Illustration



Execution time 2.10 µs (when two inputs are used) + 0.42 µs (for every additional input). When all inputs are used, the execution time is 14.55 µs.

Operation Copies the input values (IN1…32) to the corresponding outputs (OUT1…32).

Inputs The input data type and number of inputs (2…32) are selected by the user.

Input (IN1…IN32): INT, DINT, REAL, REAL24, Boolean

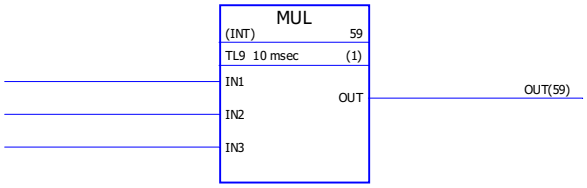
Outputs Output (OUT1…OUT32): INT, DINT, REAL, REAL24, Boolean

MUL

(10006)

Type Arithmetic

Illustration



Execution time 3.47 µs (when two inputs are used) + 2.28 µs (for every additional input). When all inputs are used, the execution time is 71.73 µs.

Operation The output (OUT) is the product of the inputs (IN).

O = IN1 × IN2 × … × IN32

The output value is limited to the maximum and minimum values defined by the selected data type range.

Inputs The input data type and the number of inputs (2…32) are selected by the user.

Input (IN1…IN32): INT, DINT, REAL, REAL24

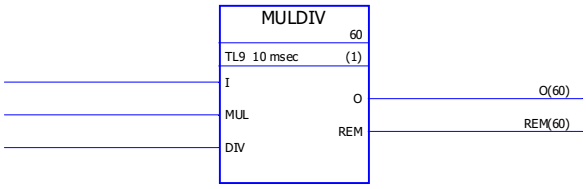
Outputs Output (OUT): INT, DINT, REAL, REAL24

MULDIV

(10007)

Type Arithmetic

Illustration



Execution time 7.10 µs

Operation The output (O) is the product of input IN and input MUL divided by input DIV.

Output = (I × MUL) / DIV

O = whole value. REM = remainder value.

Example: I = 2, MUL = 16 and DIV = 10:

(2 × 16) / 10 = 3.2, i.e. O = 3 and REM = 2

The output value is limited to the maximum and minimum values defined by the data type range.

Inputs Input (I): DINT

Multiplier input (MUL): DINT

Divider input (DIV): DINT

Outputs Output (O): DINT

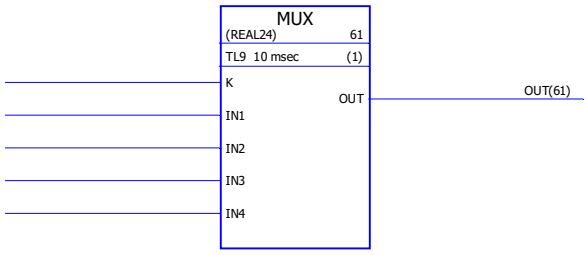
Remainder output (REM): DINT

MUX

(10055)

Type Selection

Illustration



Execution time 0.70 µs

Operation The value of an input (IN) selected by the address input (K) is stored to the output (OUT).

If the address input is 0, negative or exceeds the number of the outputs, the output is 0.

Inputs The input data type and number of inputs (2…32) are selected by the user.

Address input (K): DINT

Input (IN1…IN32): INT, DINT, REAL, REAL24

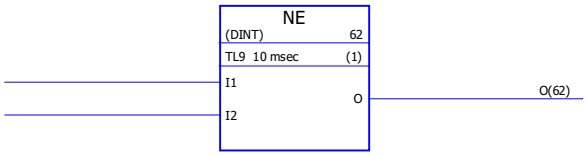
Outputs Output (OUT): INT, DINT, REAL, REAL24

NE <>

(10045)

Type Comparison

Illustration



Execution time 0.44 µs

Operation The output (O) is 1 if I1 <> I2. Otherwise the output is 0.

Inputs The input data type is selected by the user.
Input (I1, I2): INT, DINT, REAL, REAL24

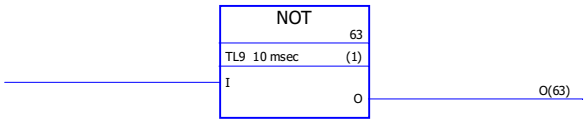
Outputs Output (O): Boolean

NOT

(10011)

Type Bitstring

Illustration



Execution time 0.32 µs

Operation The output (O) is 1 if the input (I) is 0. The output is 0 if the input is 1.

Inputs Input (I): Boolean

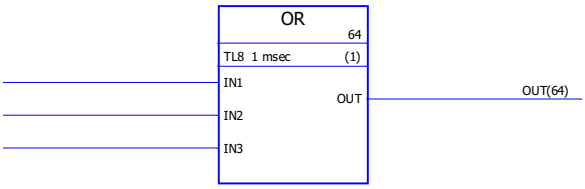
Outputs Output (O): Boolean

OR

(10012)

Type Bitstring

Illustration



Execution time 1.55 µs (when two inputs are used) + 0.60 µs (for every additional input). When all inputs are used, the execution time is 19.55 µs.

Operation The output (OUT) is 0, if all connected inputs (IN) are 0. Otherwise the output is 1.

Truth table:

IN1	IN2	OUT
0	0	0
0	1	1
1	0	1
1	1	1

The inputs can be inverted.

Inputs The number of inputs (2…32) is selected by the user.

Input (IN1…IN32): Boolean

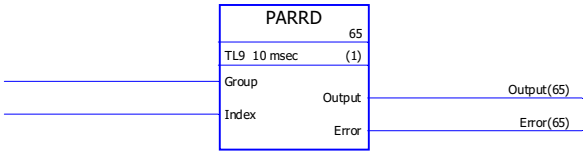
Outputs Output (OUT): Boolean

PARRD

(10082)

Type Feedback & algorithms

Illustration



Execution time 6.00 µs

Operation Output is the value of the defined parameter (Group and Index).

Error codes are indicated by the error output (Error) as follows:

Error code	Description
0	No error
≠ 0	Error

Inputs Parameter group input (Group): DINT

Parameter index input (Index): DINT

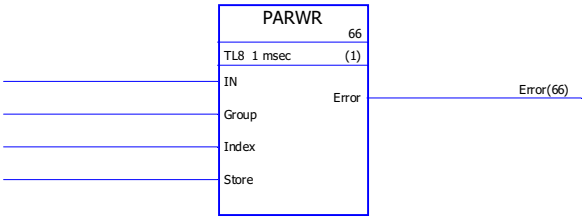
Outputs Output (Output): DINT
Error output (Error): DINT

PARWR

(10080)

Type Feedback & algorithms

Illustration



Execution time 14.50 µs

Operation The input value (IN) is written to the defined parameter (Group and Index).

The new parameter value is stored to the flash memory if the store input (Store) is 1.
Note: Cyclic parameter value storing can damage the memory unit. Parameter values should be stored only when necessary.

Error codes are indicated by the error output (Error) as follows:

Error code	Description
0	No error
< > 0	Error

Inputs Input (IN): DINT
Parameter group input (Group): DINT
Parameter index input (Index): DINT
Store input (Store): Boolean

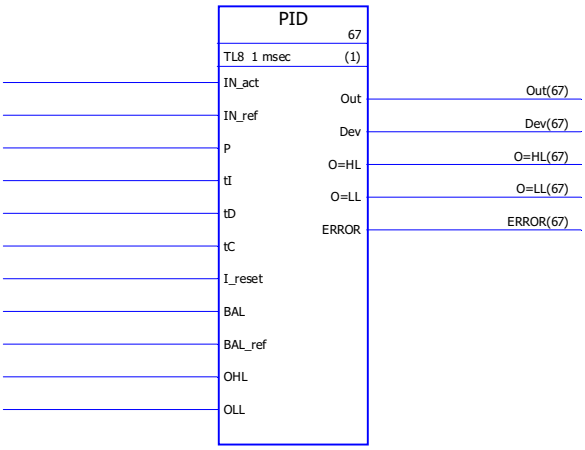
Outputs Error output (Error): DINT

PID

(10075)

Type Feedback & algorithms

Illustration



Execution time 15.75 µs

Operation

The PID controller can be used for closed-loop control systems. The controller includes anti-windup correction and output limitation.

The PID controller output (Out) before limitation is the sum of the proportional (U_P), integral (U_I) and derivative (U_D) terms:

$Out_{unlimited}$ (t) = U_P(t) + U_I(t) + U_D(t)

U_P(t) = P × Dev(t)

U_I(t) = P/tI × [$\int$ Dev(τ)dτ + tC × (Out(t) - $Out_{unlimited}$(t))]

U_D(t) = P × tD × d(Dev(t))/dt

Integrator:

The integral term can be cleared by setting I_reset to 1. Note that the anti-windup correction is simultaneously disabled. When I_reset is 1, the controller acts as a PD controller.

If integration time constant tI is 0, the integral term will not be updated.

Smooth return to normal operation is guaranteed after errors or abrupt input value changes. This is achieved by adjusting the integral term so that the output will retain its previous value during these situations.

Limitation:

The output is limited by the defined minimum and maximum values, OLL and OHL:

If the actual value of the output reaches the specified minimum limit, output O=LL is set to 1.

If the actual value of the output reaches the specified maximum limit, output O=HL is set to 1.

Smooth return to normal operation after limitation is requested if and only if the anti-windup correction is not used, i.e. when tI = 0 or tC = 0.

Error codes:

Error codes are indicated by the error output (ERROR) as follows

Error code	Description
1	The minimum limit (OLL) exceeds the maximum limit (OHL).
2	Overflow with Up, Ui, or Ud calculation

Balancing:

The balancing function (BAL) permits the output signal to track an external reference and gives a smooth return to the normal operation. If BAL is set to 1, the output (Out) is set to the value of the balance reference input (BAL_ref). Balance reference is limited by the defined minimum and maximum limits (OLL and OHL).

Anti-windup:

Anti-windup correction time constant is defined by input tC. If tC = 0 or tI = 0, anti-windup correction is disabled.

Inputs

Proportional gain input (P): REAL
Integration time constant input (tI): REAL. 1 = 1 ms
Derivation time constant input (tD): REAL. 1 = 1 ms
Antiwind-up correction time constant input (tC): IQ6. 1 = 1 ms
Output high limit input (OHL): REAL
Output low limit input (OLL): REAL
Actual input (IN_act): REAL
Reference input (IN_ref): REAL
Integrator reset input (I_reset): Boolean
Balance input (BAL): Boolean
Balance reference input (BAL_ref): REAL

Outputs

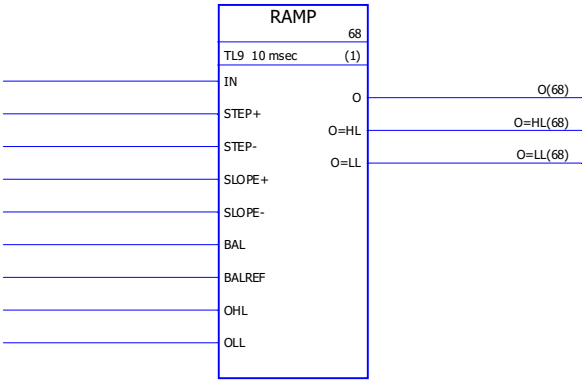
Output (Out): REAL
Error code output (ERROR): INT32
Deviation output (Dev): REAL (= actual -reference = IN_act - IN_ref)
High limit output (O=HL): Boolean
Low limit output (O=LL): Boolean

RAMP

(10066)

Type Feedback & algorithms

Illustration



Execution time 4.23 µs

Operation Limits the rate of the change of the signal.

The input signal (IN) is connected directly to the output (O) if the input signal does not exceed the defined step change limits (STEP+ and STEP-). If the input signal change exceeds these limits, the output signal change is limited by the maximum step change (STEP+/STEP- depending on the direction of rotation). After this the output signal is accelerated/decelerated according to the defined ramp times (SLOPE+/SLOPE-) until the input and output signal values are equal.

The output is limited by the defined minimum and maximum values (OLL and OHL):

If the actual value of the output exceeds the specified minimum limit (OLL), output O=LL is set to 1.

If the actual value of the output exceeds the specified maximum limit (OHL), output O=HL is set to 1.

If balancing input (BAL) is set to 1, the output (O) is set to the value of the balance reference input (BAL_ref). Balancing reference is also limited by the defined minimum and maximum values (OLL and OHL).

Inputs Input (IN): REAL

Maximum positive step change input (STEP+): REAL

Maximum negative step change input (STEP-): REAL

Positive ramp input (SLOPE+): REAL

Negative ramp input (SLOPE-): REAL

Balance input (BAL): Boolean

Balance reference input (BALREF): REAL

Output high limit input (OHL): REAL

Output low limit input (OLL): REAL

Outputs Output (O): REAL

High limit output (O=HL): Boolean

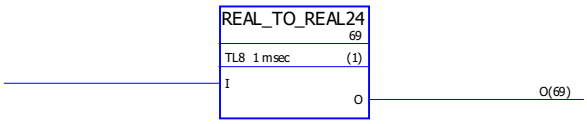
Low limit output (O=LL): Boolean

REAL_TO_REAL24

(10026)

Type Conversion

Illustration



Execution time 1.35 µs

Operation Output (O) is the REAL24 equivalent of the REAL input (I).
The output value is limited to the maximum value of the data type.
Example:

I = 0000 0000 0010 0110 1111 1111 1111 1111
(Integer value / Fractional value)

O = 0010 0110 1111 1111 1111 1111 0000 0000
(Integer value / Fractional value)

Inputs Input (I): REAL

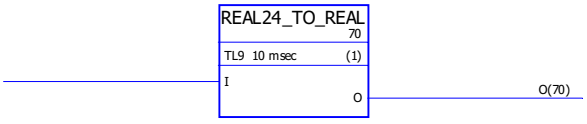
Outputs Output (O): REAL24

REAL24_TO_REAL

(10027)

Type Conversion

Illustration



Execution time 1.20 µs

Operation Output (O) is the REAL equivalent of the REAL24 input (I).
The output value is limited to the maximum value of the data type range.
Example:

I = 0010 0110 1111 1111 1111 1111 0000 0000
(Integer value / Fractional value)

O = 0000 0000 0010 0110 1111 1111 1111 1111
(Integer value / Fractional value)

Inputs Input (I): REAL24

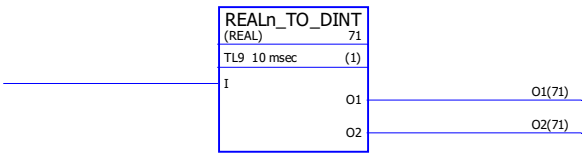
Outputs Output (O): REAL

REALn_TO_DINT

(10029)

Type Conversion

Illustration



Execution time 6.45 µs

Operation Output (O) is the 32-bit integer equivalent of the REAL/REAL24 input (I). Output O1 is the integer value and output O2 is the fractional value.

The output value is limited to the maximum value of the data type range.

Example (from REAL to DINT):

When I = 2.04998779297, O1 = 2 and O2 = 3276.

Inputs The input data type is selected by the user.

Input (I): REAL, REAL24

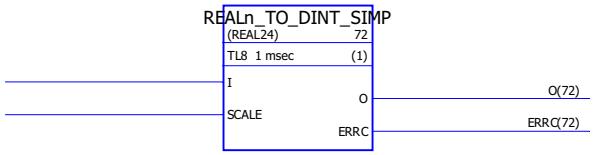
Outputs Output (O1, O2): DINT

REALn_TO_DINT_SIMP

(10028)

Type Conversion

Illustration



Execution time 5.54 µs

Operation Output (O) is the 32-bit integer equivalent of the REAL/REAL24 input (I) multiplied by the scale input (SCALE).

Error codes are indicated by the error output (ERRC) as follows:

Error code	Description
0	No error
1001	The calculated integer value exceeds the minimum value. The output is set to the minimum value.
1002	The calculated integer value exceeds the maximum value. The output is set to the maximum value.
1003	Scale input is 0. The output is set to 0.
1004	Incorrect scale input, i.e. scale input is < 0 or is not a factor of 10.

Example (from REAL to DINT):

When I = 2.04998779297and SCALE = 100, O = 204.

Inputs The input data type is selected by the user.
Input (I): REAL, REAL24
Scale input (SCALE): DINT

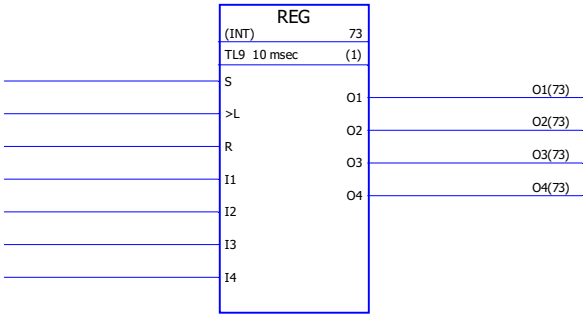
Outputs Output (O): DINT
Error output (ERRC): DINT

REG

(10038)

Type Feedback & algorithms

Illustration



Execution time 2.27 µs (when two inputs are used) + 1.02 µs (for every additional input). When all inputs are used, the execution time is 32.87 µs.

Operation The input (I1…I32) value is stored to the corresponding output (O1…O32) if the load input (L) is set to 1 or the set input (S) is 1. When the load input is set to 1, the input value is stored to the output only once. When the set input is 1, the input value is stored to the output every time the block is executed. The set input overrides the load input.

If the reset input (R) is 1, all connected outputs are 0.

Example:

S	R	L	I	$O1_{previous}$	O1
0	0	0	10	15	15
0	0	0->1	20	15	20
0	1	0	30	20	0
0	1	0->1	40	0	0
1	0	0	50	0	50
1	0	0->1	60	50	60
1	1	0	70	60	0
1	1	0->1	80	0	0
$O1_{previous}$ is the previous cycle output value.					

Inputs The input data type and number of inputs (2…32) are selected by the user.
Set input (S): Boolean
Load input (L): Boolean
Reset input (R): Boolean
Input (I1…I32): Boolean, INT, DINT, REAL, REAL24

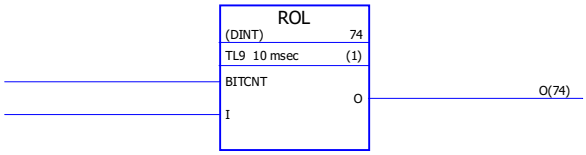
Outputs Output (O1…O32): Boolean, INT, DINT, REAL, REAL24

ROL

(10013)

Type Bitstring

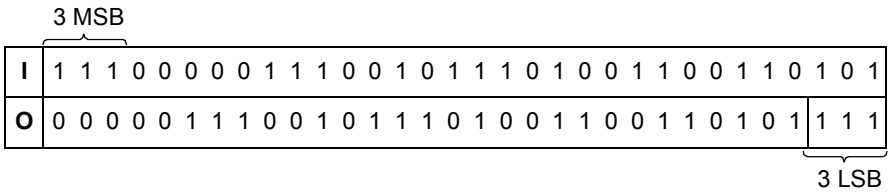
Illustration



Execution time 1.28 µs

Operation Input bits (I) are rotated to the left by the number (N) of bits defined by BITCNT. The N most significant bits (MSB) of the input are stored as the N least significant bits (LSB) of the output.

Example: If BITCNT = 3



Inputs The input data type is selected by the user.

Input (I): INT, DINT

Number of bits input (BITCNT): INT, DINT

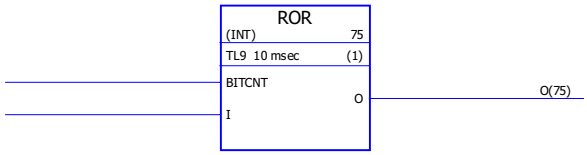
Outputs Output (O): INT, DINT

ROR

(10014)

Type Bitstring

Illustration



Execution time 1.28 µs

Operation Input bits (I) are rotated to the right by the number (N) of bits defined by BITCNT. The N least significant bits (LSB) of the input are stored as the N most significant bits (MSB) of the output.

Example: If BITCNT = 3

																										3 LSB			
I	1	1	1	0	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	0	1	0	1
O	1	0	1	1	1	1	0	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	0
	3 MSB																															

Inputs The input data type is selected by the user.

Input (I): INT, DINT

Number of bits input (BITCNT): INT, DINT

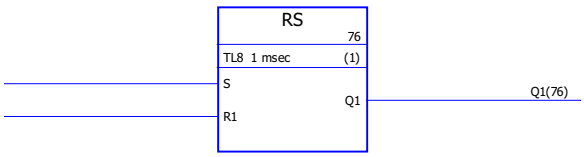
Outputs Output (O): INT, DINT

RS

(10032)

Type Edge & bistable

Illustration



Execution time 0.38 µs

Operation The output (Q1) is 0 if the set input (S) is 1 and the reset input (R) value is 0. The output will retain the previous output state if the set input (S) and the reset input (R) are 0. The output is 0 if the set input is 0 and the reset input is 1.

Truth table:

S	**R**	**$Q1_{previous}$**	**Q1**
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0
$Q_{previous}$ is the previous cycle output value.			

Inputs Set input (S): Boolean

Reset input (R): Boolean

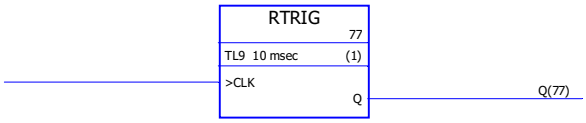
Outputs Output (Q1): Boolean

RTRIG

(10031)

Type Edge & bistable

Illustration



Execution time 0.38 µs

Operation The output (Q) is set to 1 when the clock input (CLK) changes from 0 to 1. The output is set back to 0 with the next execution of the block. Otherwise the output is 0.

$CLK_{previous}$	CLK	Q
0	0	0
0	1	1
1	0	0
1	1	0
$CLK_{previous}$ is the previous cycle output value.		

Note: The output is 0 after cold restart and after the first execution of the RTRIG block. Otherwise the output is 1, when the clock input is 1.

Inputs Clock input (CLK): Boolean

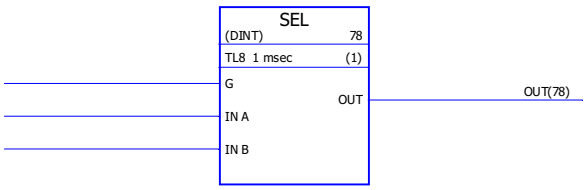
Outputs Output (Q): Boolean

SEL

(10056)

Type Selection

Illustration



Execution time 1.53 µs

Operation The output (OUT) is the value of the input (IN) selected by the selection input (G).
If G = 0: OUT = IN A.
If G = 1: OUT = IN B.

Inputs The input data type is selected by the user.
Selection input (G): Boolean
Input (IN A, IN B): Boolean, INT, DINT, REAL, REAL24

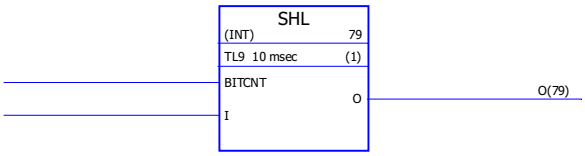
Outputs Output (OUT): Boolean, INT, DINT, REAL, REAL24

SHL

(10015)

Type Bitstring

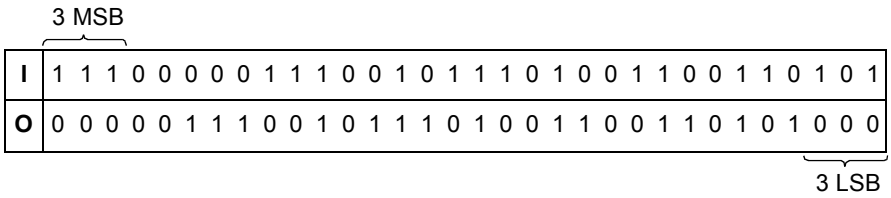
Illustration



Execution time 0.80 µs

Operation Input bits (I) are rotated to the left by the number (N) of bits defined by BITCNT. The N most significant bits (MSB) of the input are lost and the N least significant bits (LSB) of the output are set to 0.

Example: If BITCNT = 3



Inputs The input data type is selected by the user.

Input (I): INT, DINT

Number of bits (BITCNT): INT; DINT

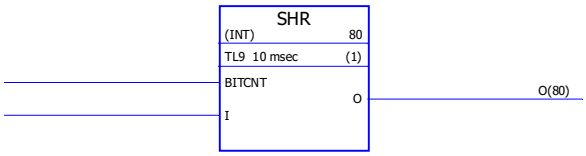
Outputs Output (O): INT; DINT

SHR

(10016)

Type Bitstring

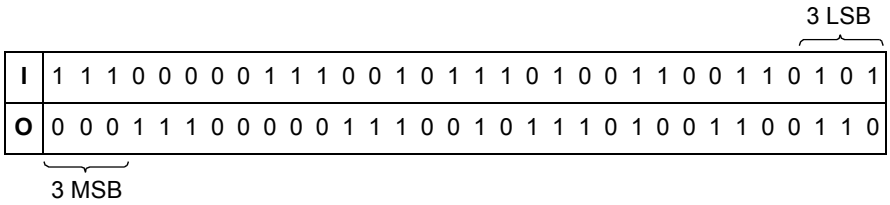
Illustration



Execution time 0.80 µs

Operation Input bits (I) are rotated to the right by the number (N) of bits defined by BITCNT. The N least significant bits (LSB) of the input are lost and the N most significant bits (MSB) of the output are set to 0.

Example: If BITCNT = 3



Inputs The input data type is selected by the user.

Input (I): INT, DINT

Number of bits (BITCNT): INT; DINT

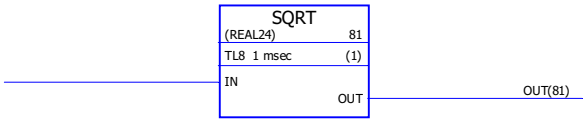
Outputs Output (O): INT; DINT

SQRT

(10008)

Type Arithmetic

Illustration



Execution time 2.09 µs

Operation Output (OUT) is the square root of the input (IN).

OUT = sqrt(IN)

Output is 0 if the input value is negative.

Inputs The input data type is selected by the user.

Input (IN): REAL, REAL24

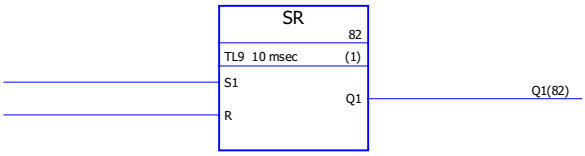
Outputs Output (OUT): REAL, REAL24

SR

(10033)

Type Edge & bistable

Illustration



Execution time 0.38 µs

Operation The output (Q1) is 1 if the set input (S1) is 1. The output will retain the previous output state if the set input (S1) and the reset input (R) are 0. The output is 0 if the set input is 0 and the reset input is 1.

Truth table:

S1	**R**	**$Q1_{previous}$**	**Q1**
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1
$Q1_{previous}$ is the previous cycle output value.			

Inputs Set input (S1): Boolean

Reset input (R): Boolean

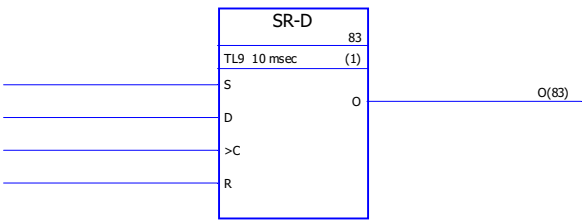
Outputs Output (Q1): Boolean

SR-D

(10039)

Type Bitwise

Illustration



Execution time 1.04 µs

Operation

When clock input (C) is set to 1, the data input (D) value is stored to the output (O). When reset input (R) is set to 1, the output is set to 0.

If only set (S) and reset (R) inputs are used, SR-D block acts as an *SR* block:
The output is 1 if the set input (S) is 1. The output will retain the previous output state if the set input (S) and reset input (R) are 0. The output is 0 if the set input is 0 and the reset input is 1.

Truth table:

S	**R**	**D**	**C**	**$O_{previous}$**	**O**
0	0	0	0	0	0 (= Previous output value)
0	0	0	0 -> 1	0	0 (= Data input value)
0	0	1	0	0	0 (= Previous output value)
0	0	1	0 -> 1	0	1 (= Data input value)
0	1	0	0	1	0 (Reset)
0	1	0	0 -> 1	0	0 (Reset)
0	1	1	0	0	0 (Reset)
0	1	1	0 -> 1	0	0 (Reset)
1	0	0	0	0	1 (= Set value)
1	0	0	0 -> 1	1	0 (= Data input value) for one execution cycle, then changes to 1 according to the set input (S = 1).
1	0	1	0	1	1 (= Set value)
1	0	1	0 -> 1	1	1 (= Data input value)
1	1	0	0	1	0 (Reset)
1	1	0	0 -> 1	0	0 (Reset)
1	1	1	0	0	0 (Reset)
1	1	1	0 -> 1	0	0 (Reset)
$O_{previous}$ is the previous cycle output value.					

Inputs

Set input (S): Boolean

Data input (D): Boolean

Clock input (C): Boolean

Reset input (R): Boolean

Outputs

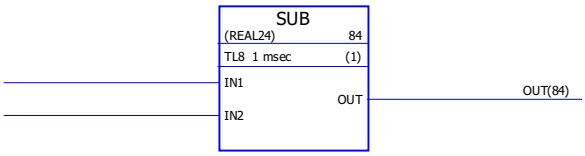
Output (O): Boolean

SUB -

(10009)

Type Arithmetic

Illustration



Execution time 2.33 µs

Operation Output (OUT) is the difference between the input signals (IN):

OUT = IN1 - IN2

The output value is limited to the maximum and minimum values defined by the selected data type range.

Inputs The input data type is selected by the user.

Input (IN1, IN2): INT, DINT, REAL, REAL24

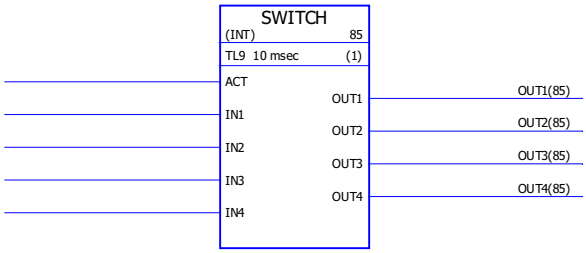
Outputs Output (OUT): INT, DINT, REAL, REAL24

SWITCH

(10063)

Type Switch & Demux

Illustration



Execution time 0.68 µs (when two inputs are used) + 0.50 µs (for every additional input). When all inputs are used, the execution time is 15.80 µs.

Operation The output (OUT) is equal to the corresponding input (IN) if the activate input (ACT) is 1. Otherwise the output is 0.

Inputs The input data type and the number of inputs (2…32) are selected by the user.

Activate input (ACT): Boolean

Input (IN1…IN32): INT, DINT, REAL, REAL24, Boolean

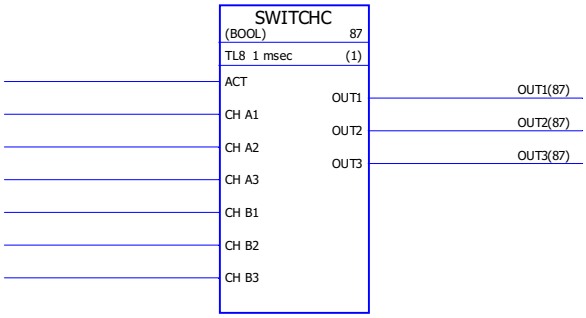
Outputs Output (OUT1…OUT32): INT, DINT, REAL, REAL24, Boolean

SWITCHC

(10064)

Type Switch & Demux

Illustration



Execution time 1.53 µs (when two inputs are used) + 0.73 µs (for every additional input). When all inputs are used, the execution time is 23.31 µs.

Operation The output (OUT) is equal to the corresponding channel A input (CH A1…32) if the activate input (ACT) is 0. The output is equal to the corresponding channel B input (CH B1…32) if the activate input (ACT) is 1.

Inputs The input data type and the number of inputs (2…32) are selected by the user.

Activate input (ACT): Boolean

Input (CH A1…CH A32, CH B1…CH B32): INT, DINT, REAL, REAL24, Boolean

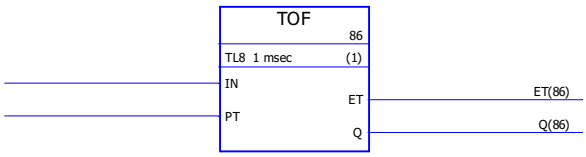
Outputs Output (OUT1…OUT32): INT, DINT, REAL, REAL24, Boolean

TOF

(10058)

Type Timer

Illustration

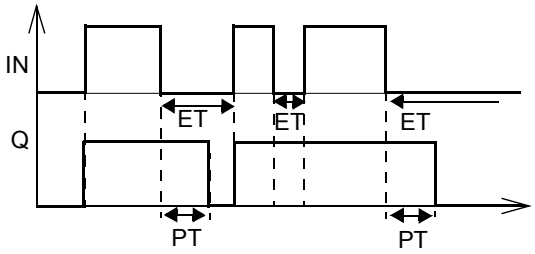


Execution time 1.10 µs

Operation The output (Q) is set to 1, when the input (IN) is set to 1. The output is reset to zero when the input has been 0 for a time defined by the pulse time input (PT).

Elapsed time count (TE) starts when the input is set to 0 and stops when the input is set to 1.

Example:



Inputs Input (IN): Boolean

Pulse time input (PT): DINT (1 = 1 µs)

Outputs Output (Q): Boolean

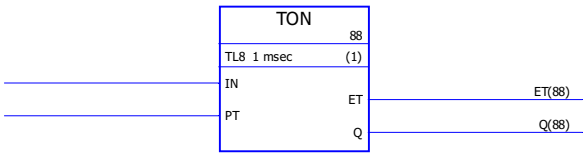
Elapsed time output (ET): DINT (1 = 1 µs)

TON

(10059)

Type Timer

Illustration

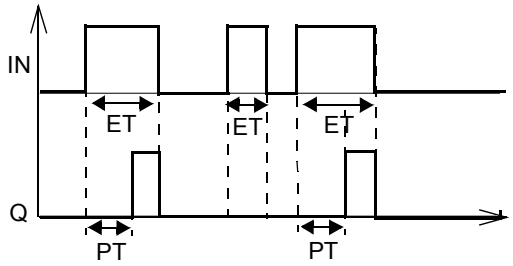


Execution time 1.22 µs

Operation The output (Q) is set to 1 when the input (IN) has been 1 for a time defined by the pulse time input (PT). The output is set to 0, when the input is set to 0.

Elapsed time count (TE) starts when the input is set to 1 and stops when the input is set to 0.

Example:



Inputs Input (IN): Boolean

Pulse time input (PT): DINT (1 = 1 µs)

Outputs Output (Q): Boolean

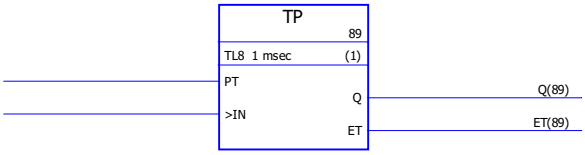
Elapsed time output (ET): DINT (1 = 1 µs)

TP

(10060)

Type Timer

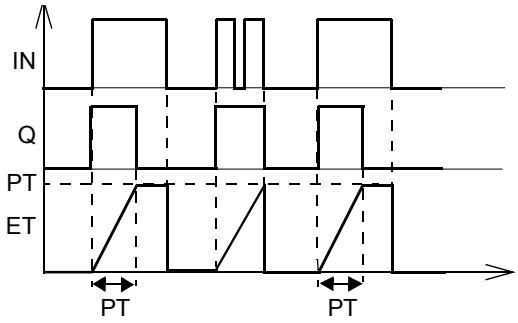
Illustration



Execution time 1.46 µs

Operation The output (Q) is set to 1 when the input (IN) is set to 1. The output is set to 0, when it has been 1 for a time defined by the pulse time input (PT).

Elapsed time count (TE) starts when the input is set to 1 and stops when the input is set to 0.



Inputs Input (IN): Boolean

Pulse time input (PT): DINT (1 = 1 µs)

Outputs Output (Q): Boolean

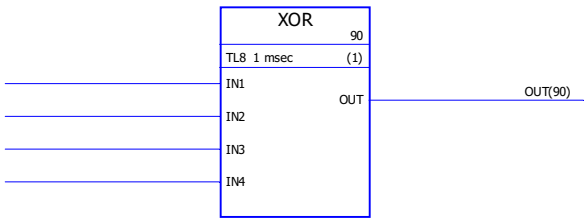
Elapsed time output (ET): DINT (1 = 1 µs)

XOR

(10017)

Type Bitstring

Illustration



Execution time 1.24 µs (when two inputs are used) + 0.72 µs (for every additional input). When all inputs are used, the execution time is 22.85 µs.

Operation The output (OUT) is 1 if one of the connected inputs (IN1…IN32) is 1. Output is zero if all the inputs have the same value.

Example:

IN1	IN2	OUT
0	0	0
0	1	1
1	0	1
1	1	0

The inputs can be inverted.

Inputs The number of inputs (2…32) is selected by the user.

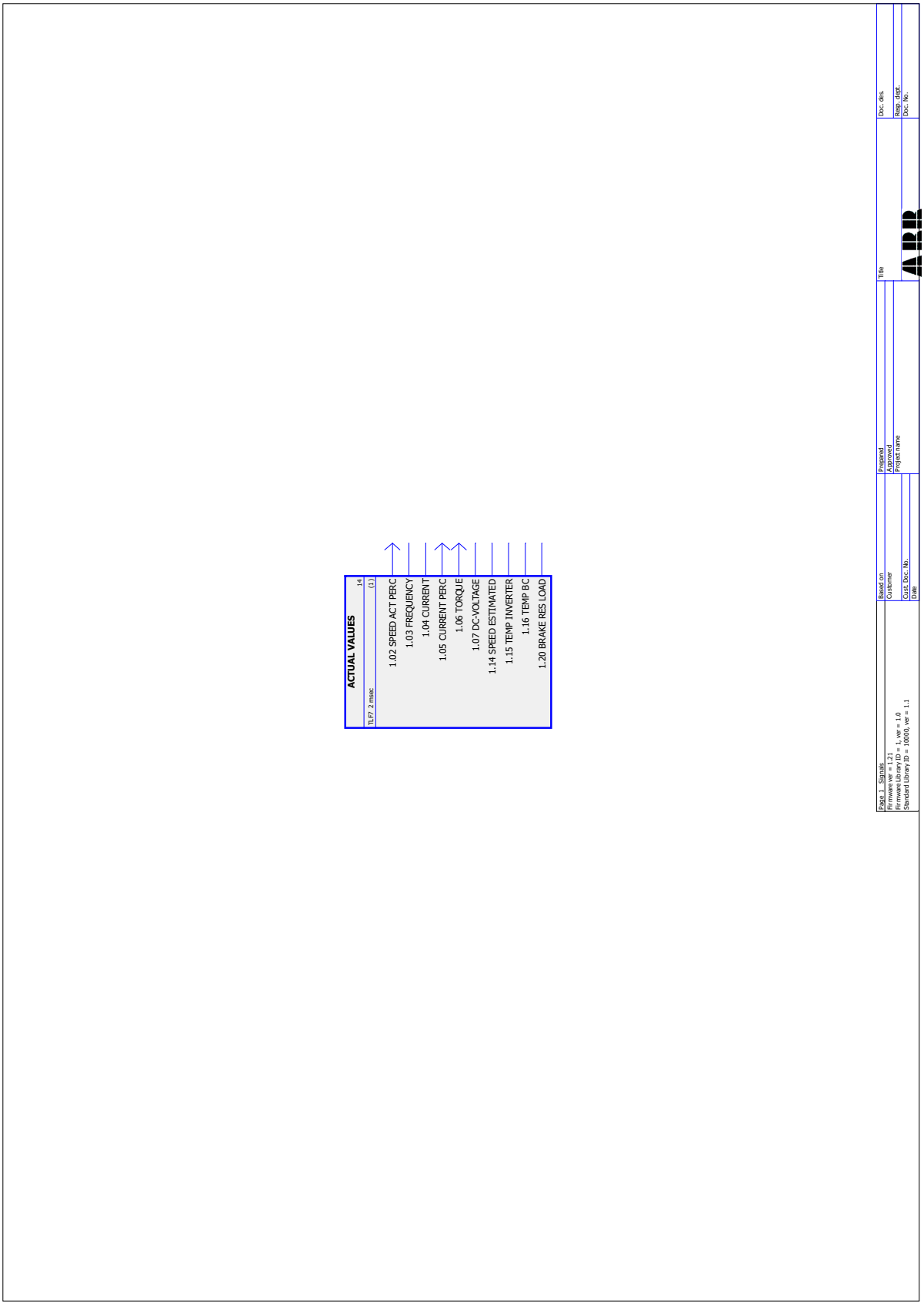
Input (IN1…IN32): Boolean

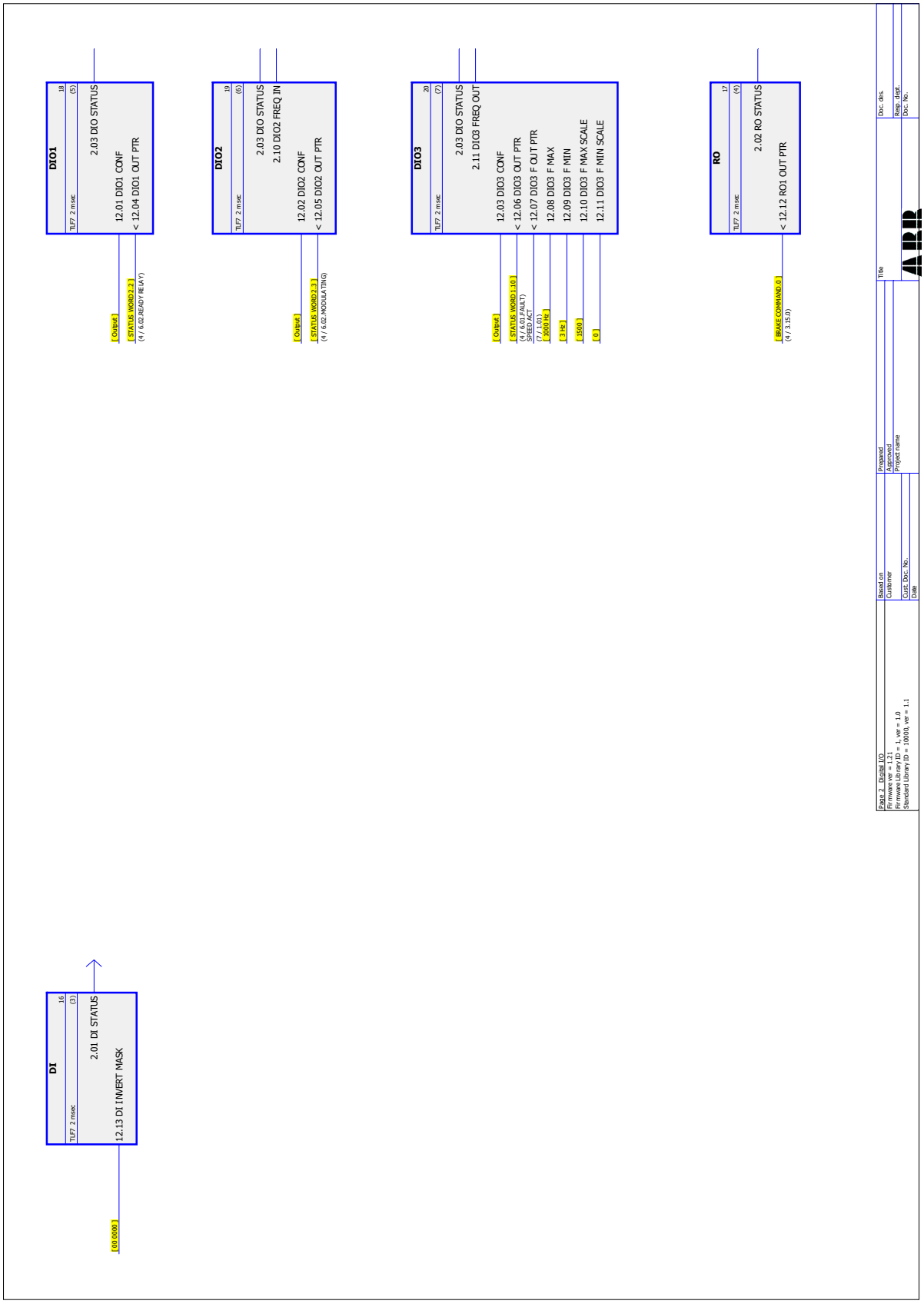
Outputs Output (OUT): Boolean

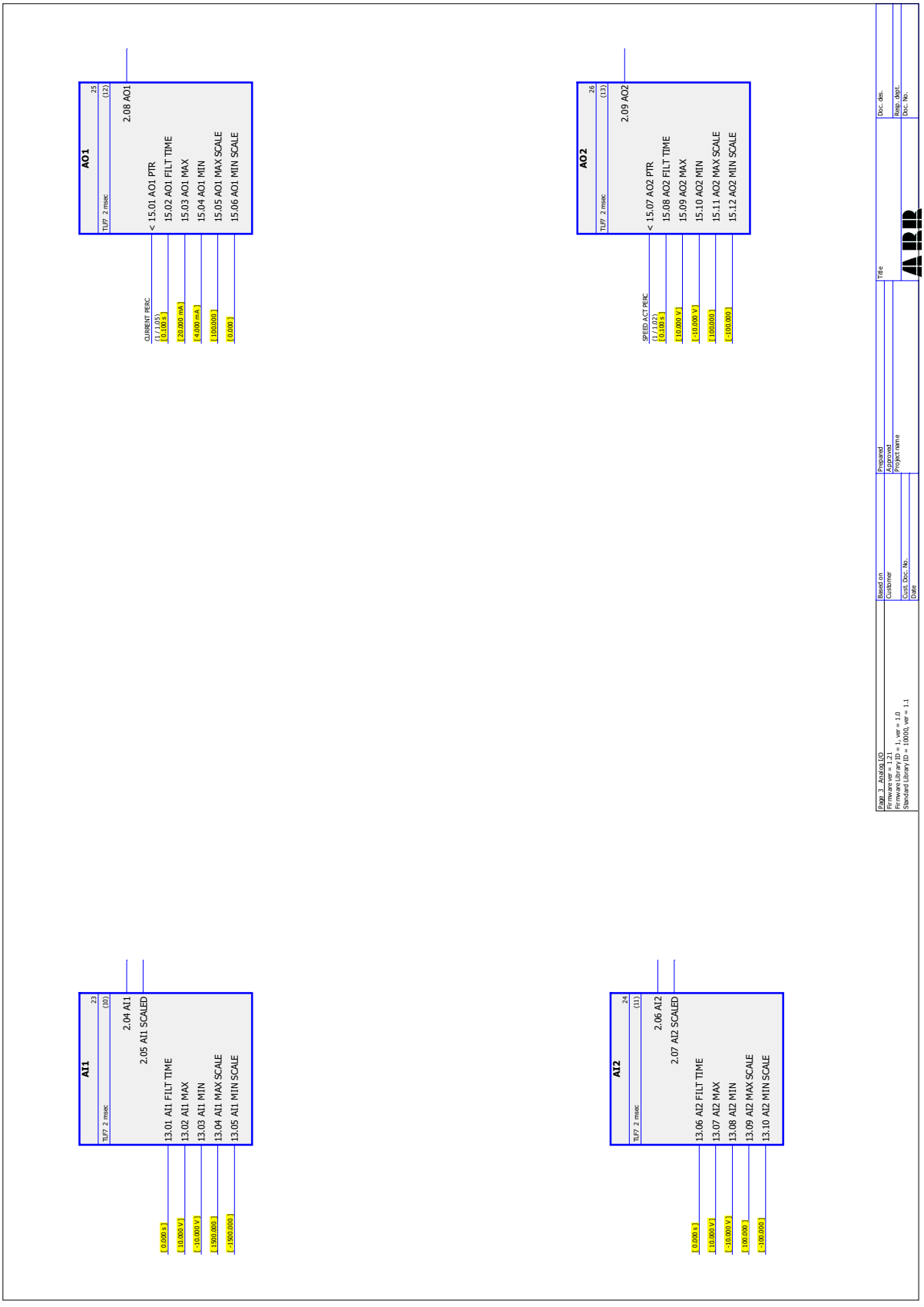
Control block diagrams

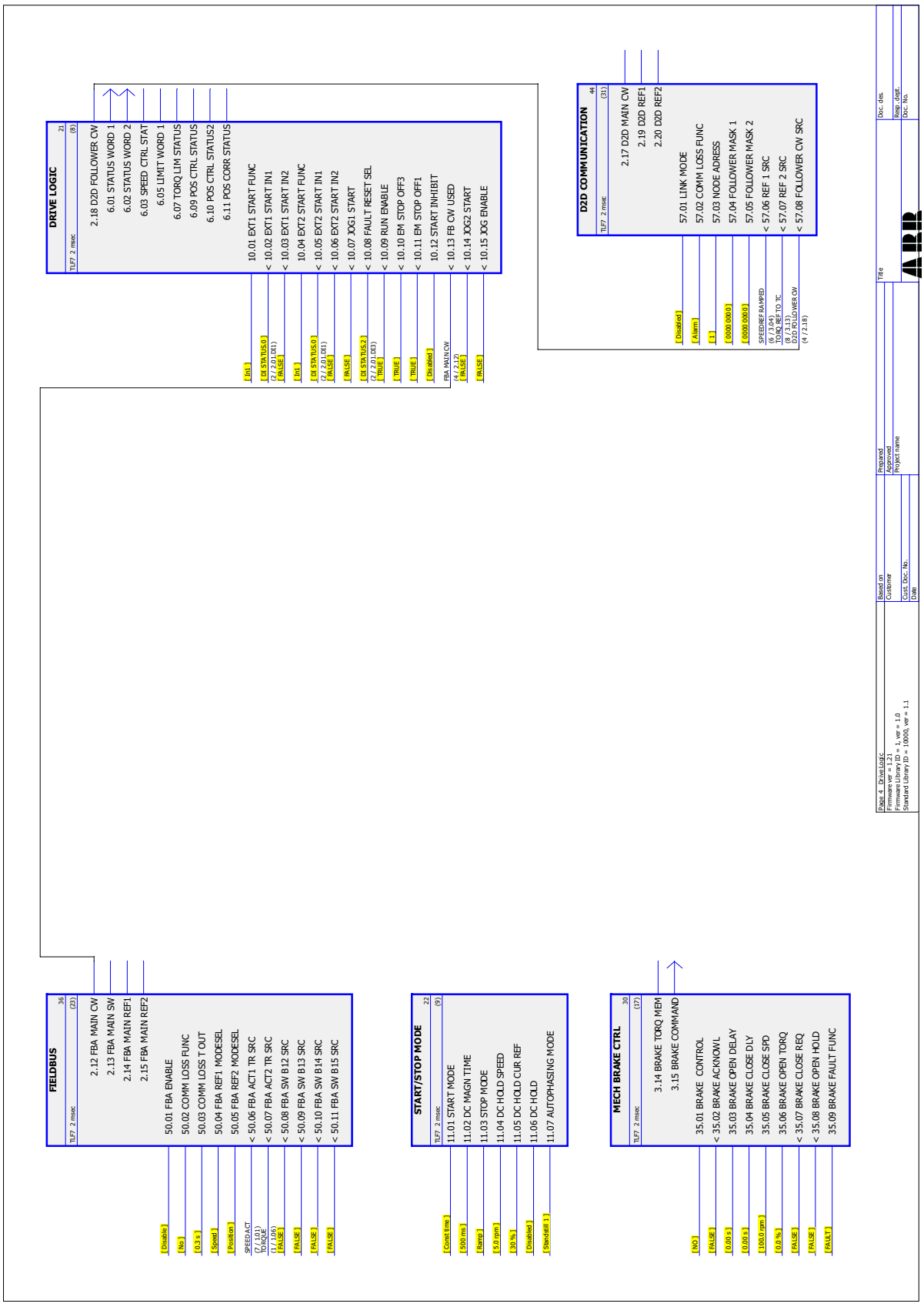
What this chapter contains

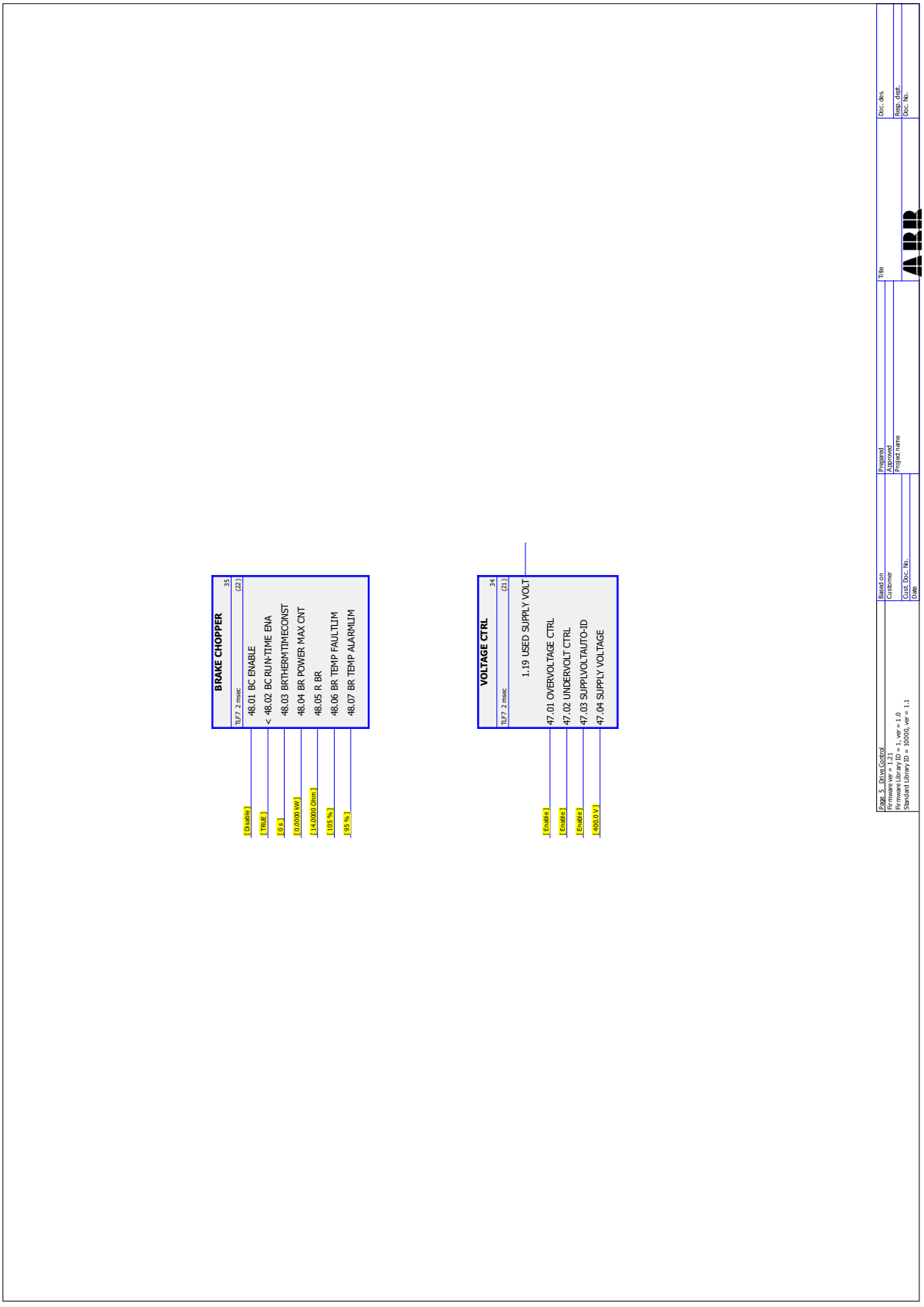
This chapter presents the Solution Program pages containing the firmware blocks.

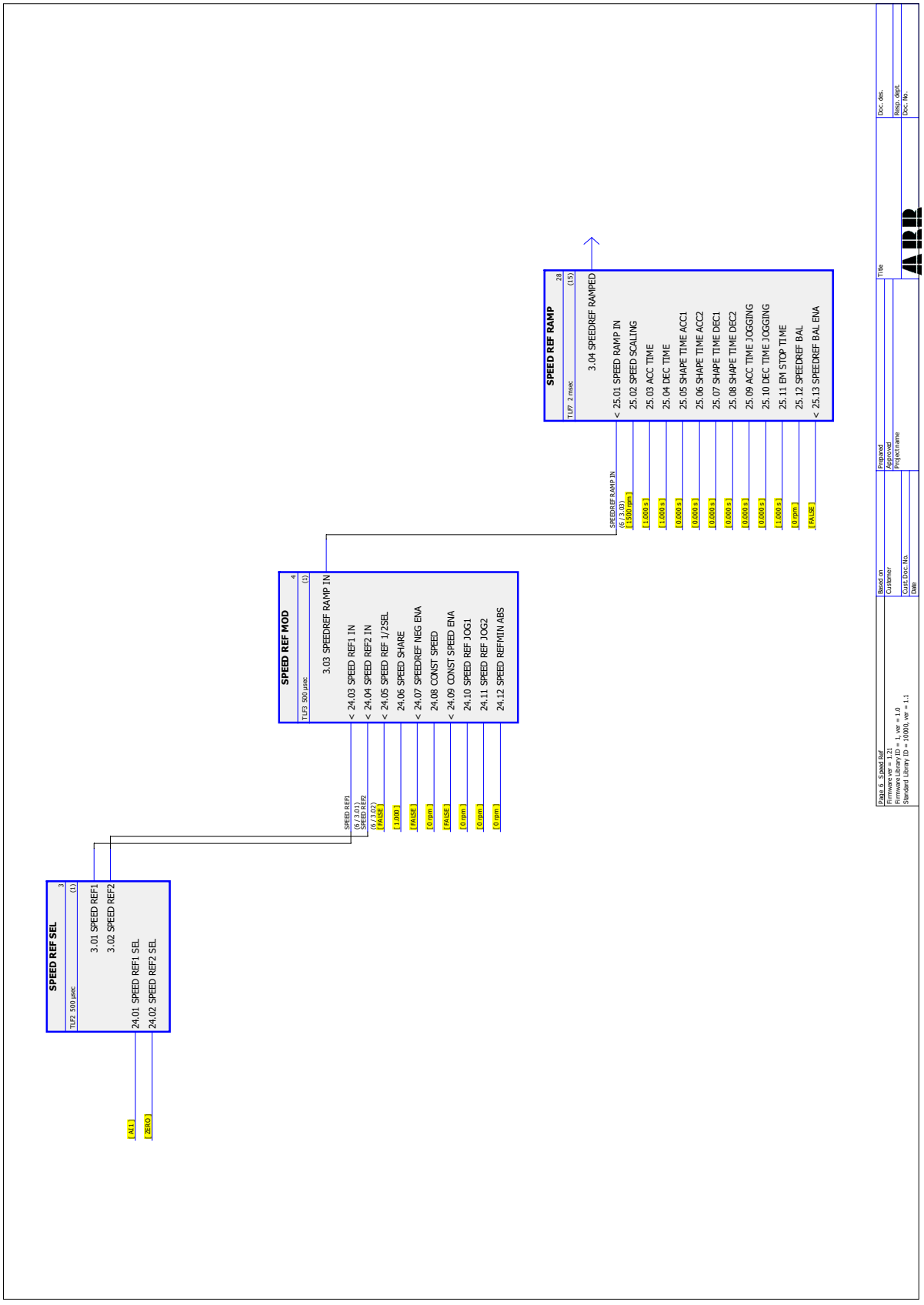

ACTUAL VALUES
14
(1)
TLF7 2 msec
1.02 SPEED ACT PERC
1.03 FREQUENCY
1.04 CURRENT
1.05 CURRENT PERC
1.06 TORQUE
1.07 DC-VOLTAGE
1.14 SPEED ESTIMATED
1.15 TEMP INVERTER
1.16 TEMP BC
1.20 BRAKE RES LOAD
Page 1 - Signals
Firmware ver = 1.21
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Code Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. des.
Resp. dept.
Doc. No.
ABB

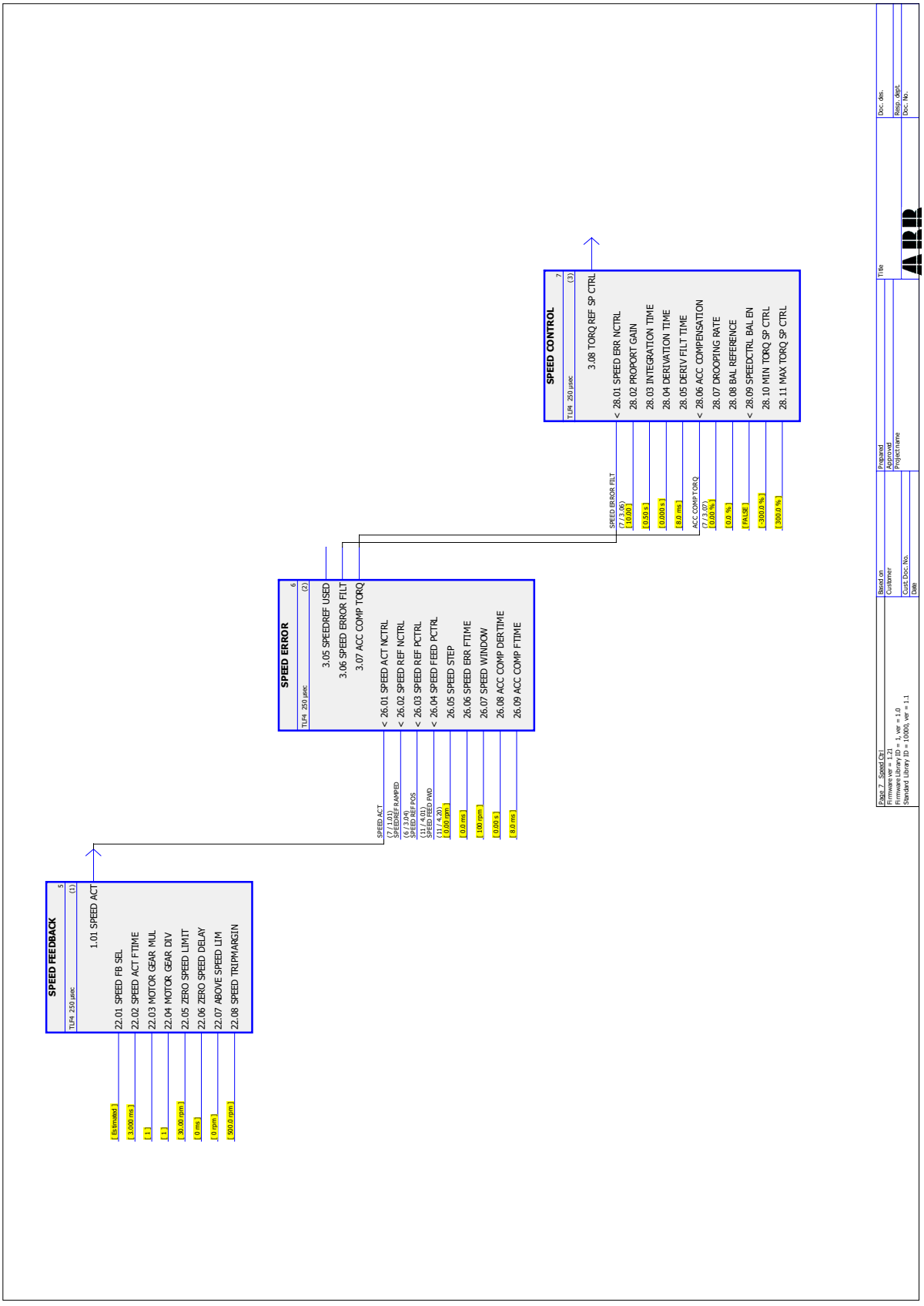

DIO1
TLF7 2 msec
2.03 DIO STATUS
12.01 DIO1 CONF
< 12.04 DIO1 OUT PTR
Output
STATUS WORD 2.2.1
(4 / 6.02 READY RELAY)
DIO2
TLF7 2 msec
2.03 DIO STATUS
2.10 DIO2 FREQ IN
12.02 DIO2 CONF
< 12.05 DIO2 OUT PTR
Output
STATUS WORD 2.3.1
(4 / 6.02 MODULATING)
DIO3
TLF7 2 msec
2.03 DIO STATUS
2.11 DIO3 FREQ OUT
12.03 DIO3 CONF
< 12.06 DIO3 OUT PTR
< 12.07 DIO3 F OUT PTR
12.08 DIO3 F MAX
12.09 DIO3 F MIN
12.10 DIO3 F MAX SCALE
12.11 DIO3 F MIN SCALE
Output
STATUS WORD 1.10.1
(4 / 6.01 AT/AULT)
SPEED ACT
(7 / 1.01)
1000 Hz
3 Hz
1500
0
RO
TLF7 2 msec
2.02 RO STATUS
< 12.12 RO1 OUT PTR
BRAKE COMMAND 0.1
(4 / 3.15.0)
DI
TLF7 2 msec
2.01 DI STATUS
12.13 DI INVERT MASK
00.0000
Page 2 Digital I/O
Firmware ver = 1.72
Firmware library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Cust. Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. des.
Resp. dept.
Doc. No.
ABB

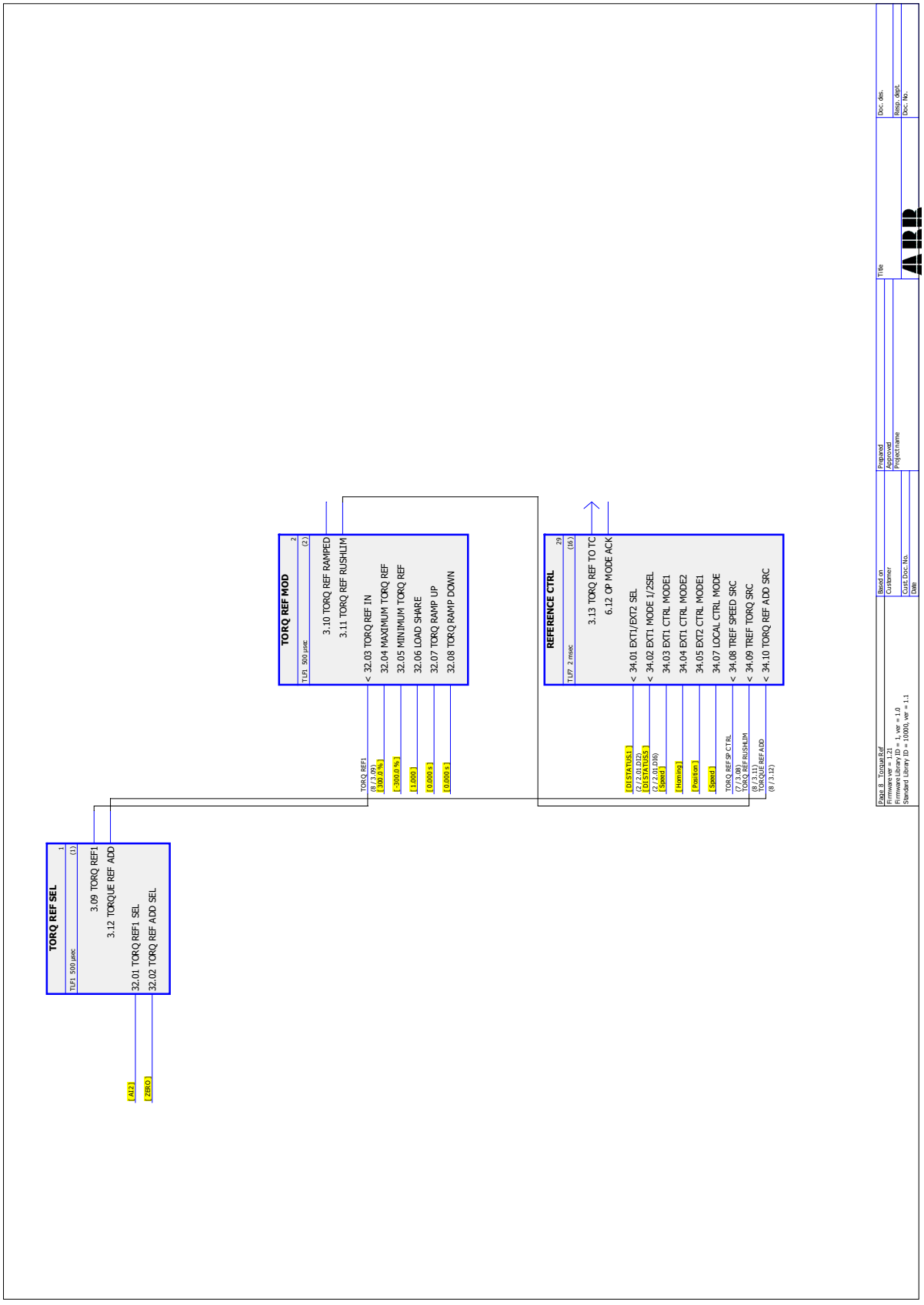

AO1
25
TUF 2 msec
(12)
2.08 AO1
< 15.01 AO1 PTR
15.02 AO1 FILT TIME
15.03 AO1 MAX
15.04 AO1 MIN
15.05 AO1 MAX SCALE
15.06 AO1 MIN SCALE
CURRENT PERC
(1 / 1.05)
0.100 s
20.000 mA
4.000 mA
100.000
0.000
AO2
26
TUF 2 msec
(13)
2.09 AO2
< 15.07 AO2 PTR
15.08 AO2 FILT TIME
15.09 AO2 MAX
15.10 AO2 MIN
15.11 AO2 MAX SCALE
15.12 AO2 MIN SCALE
SPEED ACT PERC
(1 / 1.02)
0.100 s
10.000 V
-10.000 V
100.000
-100.000
AI1
23
TUF 2 msec
(10)
2.04 AI1
2.05 AI1 SCALED
13.01 AI1 FILT TIME
13.02 AI1 MAX
13.03 AI1 MIN
13.04 AI1 MAX SCALE
13.05 AI1 MIN SCALE
0.000 s
10.000 V
-10.000 V
1.500.000
-1.500.000
AI2
24
TUF 2 msec
(11)
2.06 AI2
2.07 AI2 SCALED
13.06 AI2 FILT TIME
13.07 AI2 MAX
13.08 AI2 MIN
13.09 AI2 MAX SCALE
13.10 AI2 MIN SCALE
0.000 s
10.000 V
-10.000 V
100.000
-100.000
Page 3 Analog I/O
Firmware ver = 1.21
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Cust. Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. des.
Resp. dept.
Doc. No.
ABB

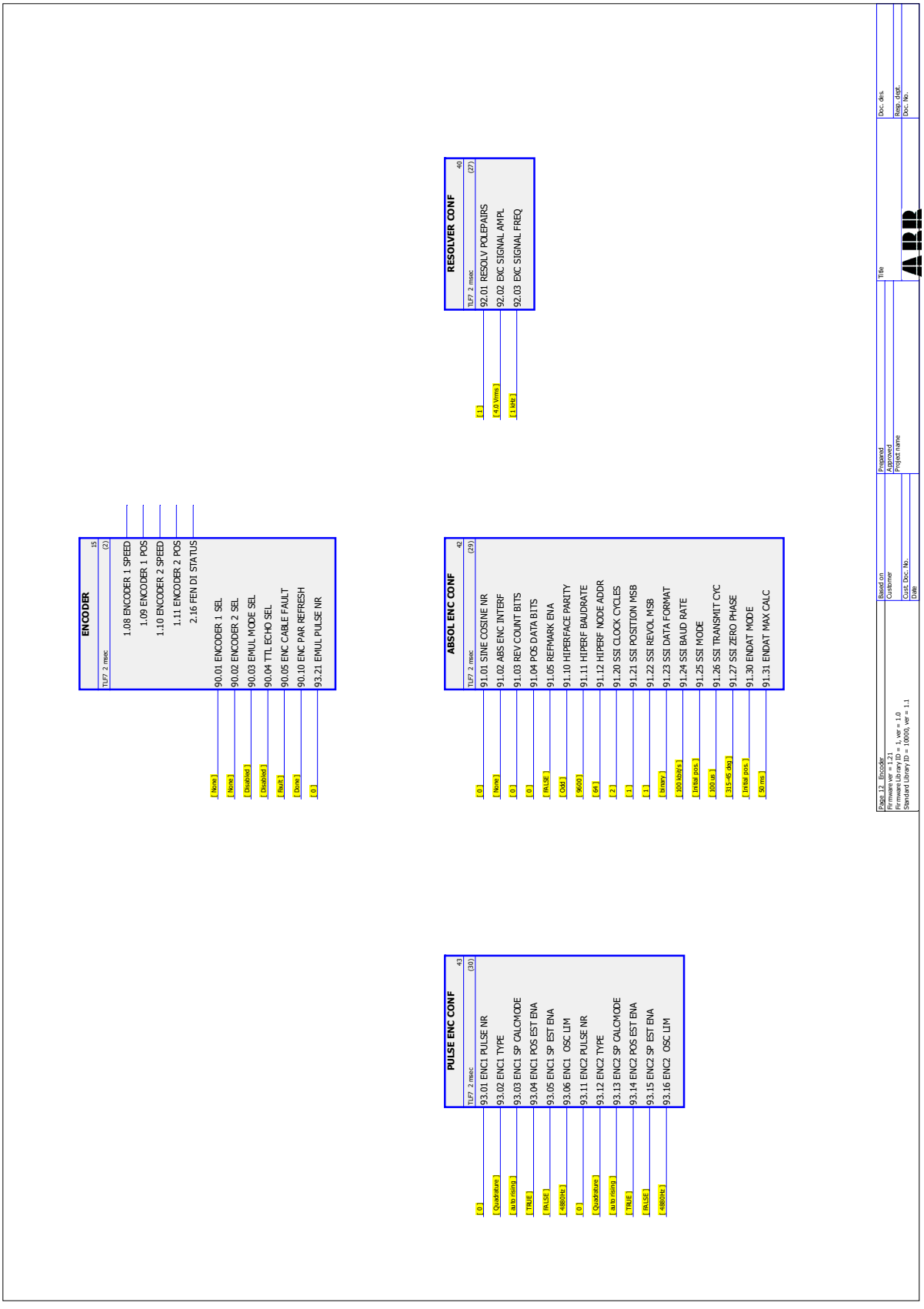

DRIVE LOGIC
2.18 D2D FOLLOWER CW
6.01 STATUS WORD 1
6.02 STATUS WORD 2
6.03 SPEED CTRL STAT
6.05 LIMIT WORD 1
6.07 TORQ LIM STATUS
6.09 POS CTRL STATUS
6.10 POS CTRL STATUS2
6.11 POS CORR STATUS
10.01 EXT1 START FUNC
10.02 EXT1 START IN1
10.03 EXT1 START IN2
10.04 EXT2 START FUNC
10.05 EXT2 START IN1
10.06 EXT2 START IN2
10.07 JOG1 START
10.08 FAULT RESET SEL
10.09 RUN ENABLE
10.10 EM STOP OFF3
10.11 EM STOP OFF1
10.12 START INHIBIT
10.13 FB CW USED
10.14 JOG2 START
10.15 JOG ENABLE
D2D COMMUNICATION
2.17 D2D MAIN CW
2.19 D2D REF1
2.20 D2D REF2
57.01 LINK MODE
57.02 COMM LOSS FUNC
57.03 NODE ADRESS
57.04 FOLLOWER MASK 1
57.05 FOLLOWER MASK 2
57.06 REF 1 SRC
57.07 REF 2 SRC
57.08 FOLLOWER CW SRC
FIELDBUS
2.12 FBA MAIN CW
2.13 FBA MAIN SW
2.14 FBA MAIN REF1
2.15 FBA MAIN REF2
50.01 FBA ENABLE
50.02 COMM LOSS FUNC
50.03 COMM LOSS T OUT
50.04 FBA REF1 MODESEL
50.05 FBA REF2 MODESEL
50.06 FBA ACT1 TR SRC
50.07 FBA ACT2 TR SRC
50.08 FBA SW B12 SRC
50.09 FBA SW B13 SRC
50.10 FBA SW B14 SRC
50.11 FBA SW B15 SRC
START/STOP MODE
11.01 START MODE
11.02 DC MAGN TIME
11.03 STOP MODE
11.04 DC HOLD SPEED
11.05 DC HOLD CUR REF
11.06 DC HOLD
11.07 AUTOPHASING MODE
MECH BRAKE CTRL
3.14 BRAKE TORQ MEM
3.15 BRAKE COMMAND
35.01 BRAKE CONTROL
35.02 BRAKE ACKNOWL
35.03 BRAKE OPEN DELAY
35.04 BRAKE CLOSE DLY
35.05 BRAKE CLOSE SPD
35.06 BRAKE OPEN TORQ
35.07 BRAKE CLOSE REQ
35.08 BRAKE OPEN HOLD
35.09 BRAKE FAULT FUNC
ABB

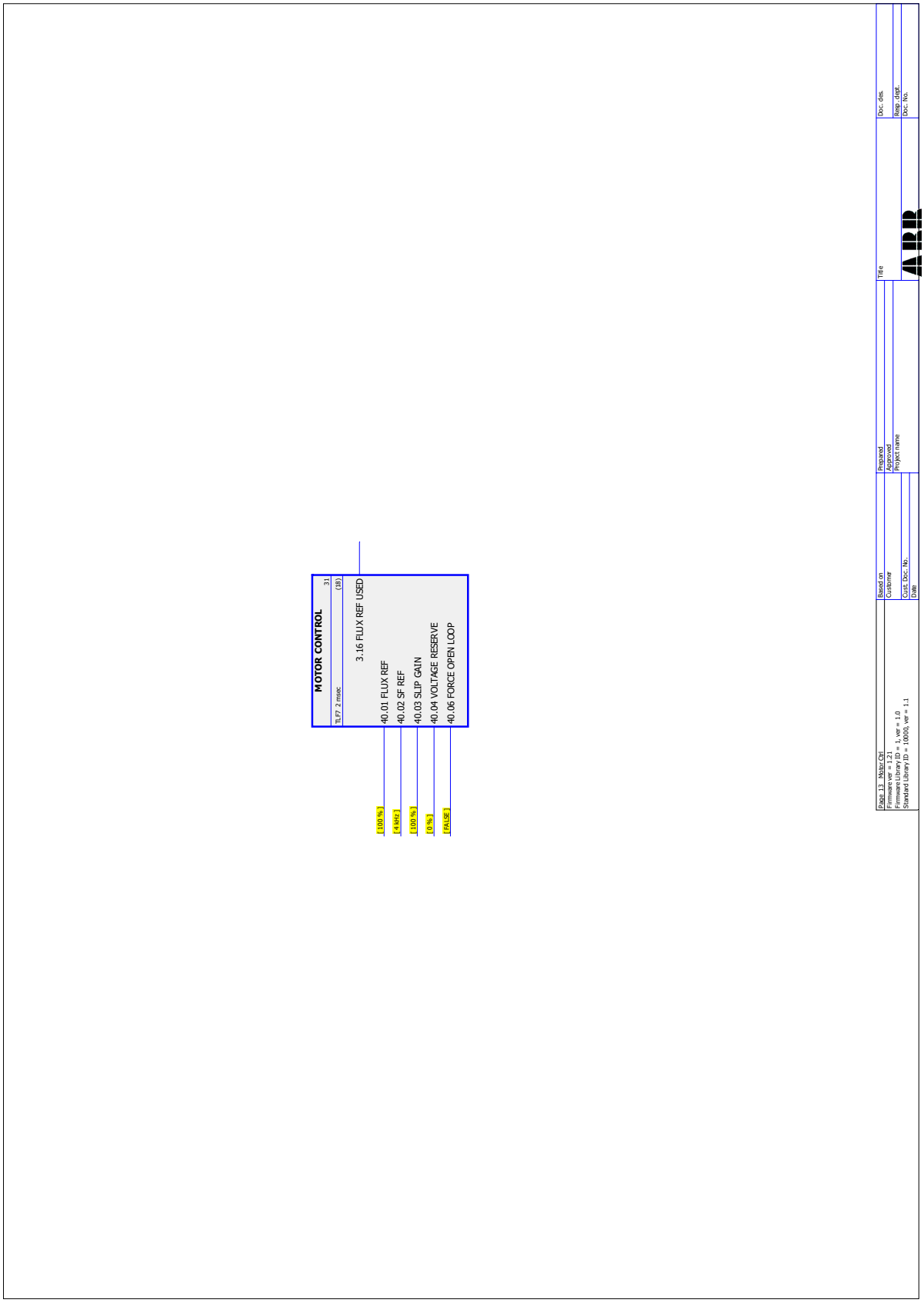

BRAKE CHOPPER
35
TLF7 2 msec
(22)
48.01 BC ENABLE
< 48.02 BC RUN-TIME ENA
48.03 BRTHERMTIMECONST
48.04 BR POWER MAX CNT
48.05 R BR
48.06 BR TEMP FAULTLIM
48.07 BR TEMP ALARMLIM
[Disable]
[TRUE]
[0 s]
[0.0000 kW]
[4.0000 Ohm]
[105 %]
[95 %]
VOLTAGE CTRL
34
TLF7 2 msec
(21)
1.19 USED SUPPLY VOLT
47.01 OVERVOLTAGE CTRL
47.02 UNDERVOLT CTRL
47.03 SUPPLVOLTAUTO-ID
47.04 SUPPLY VOLTAGE
[Enable]
[Enable]
[Enable]
[400.0 V]
Page 5 - Drive Control
Firmware ver = 1.21
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Cust. Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. des.
Resp. dept.
Doc. No.

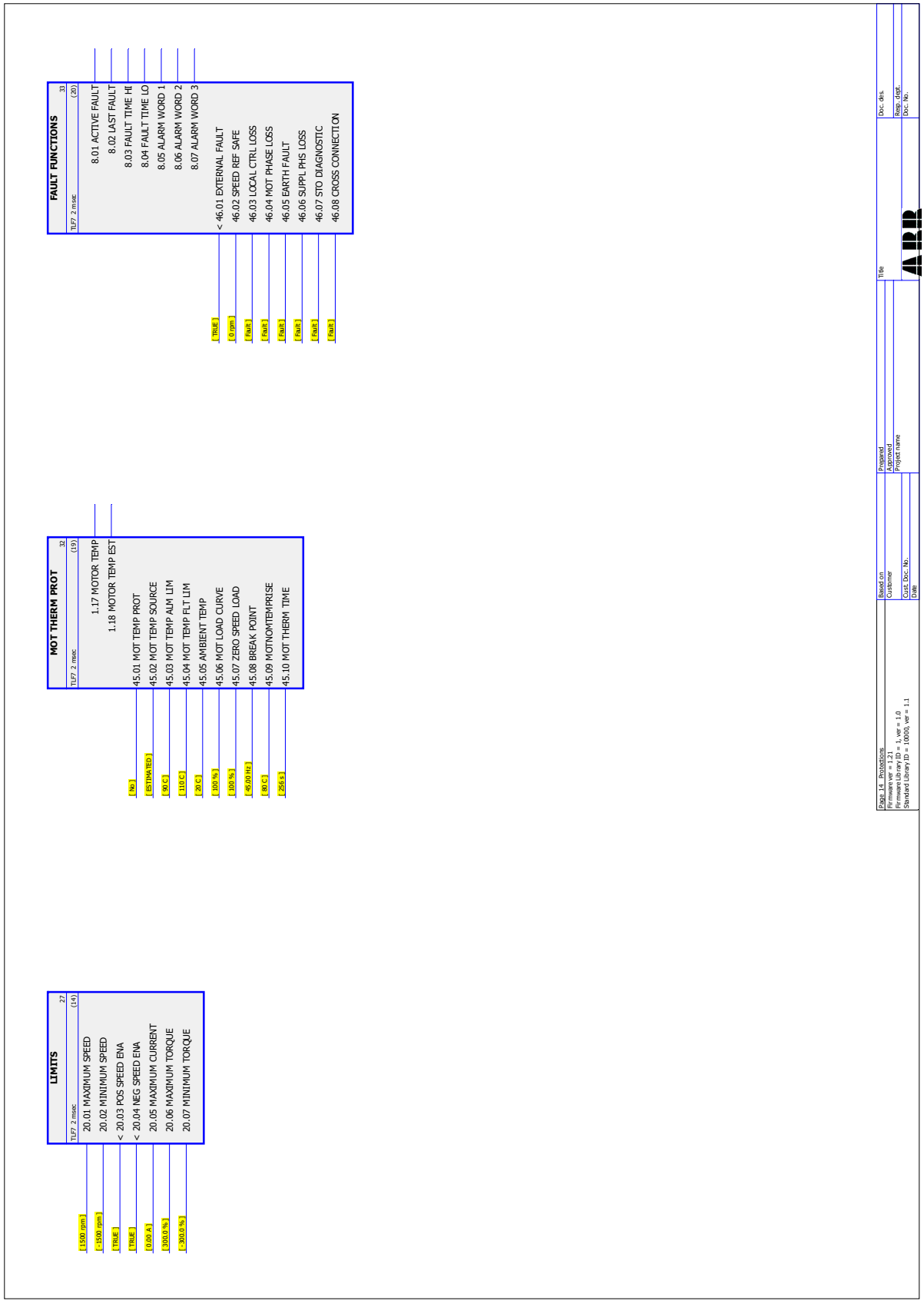

SPEED REF SEL
3
(1)
TLP2 500 µsec
3.01 SPEED REF1
3.02 SPEED REF2
24.01 SPEED REF1 SEL
24.02 SPEED REF2 SEL
[A1]
[ZERO]
SPEED REF MOD
4
(1)
TLF3 500 µsec
3.03 SPEEDREF RAMP IN
< 24.03 SPEED REF1 IN
< 24.04 SPEED REF2 IN
< 24.05 SPEED REF 1/2SEL
24.06 SPEED SHARE
< 24.07 SPEEDREF NEG ENA
24.08 CONST SPEED
< 24.09 CONST SPEED ENA
24.10 SPEED REF JOG1
24.11 SPEED REF JOG2
24.12 SPEED REFMIN ABS
SPEED REF1
(6 / 3.01)
SPEED REF2
(6 / 3.02)
[FALSE]
[1.000]
[FALSE]
[0 rpm]
[FALSE]
[0 rpm]
[0 rpm]
[0 rpm]
SPEED REF RAMP
28
(15)
TLF7 2 msec
3.04 SPEEDREF RAMPED
< 25.01 SPEED RAMP IN
25.02 SPEED SCALING
25.03 ACC TIME
25.04 DEC TIME
25.05 SHAPE TIME ACC1
25.06 SHAPE TIME ACC2
25.07 SHAPE TIME DEC1
25.08 SHAPE TIME DEC2
25.09 ACC TIME JOGGING
25.10 DEC TIME JOGGING
25.11 EM STOP TIME
25.12 SPEEDREF BAL
< 25.13 SPEEDREF BAL ENA
SPEEDREF RAMP IN
(6 / 3.03)
[1500 rpm]
[1.000 s]
[1.000 s]
[0.000 s]
[0.000 s]
[0.000 s]
[0.000 s]
[0.000 s]
[0.000 s]
[1.000 s]
[0 rpm]
[FALSE]
Title
Doc. obs.
Resp. dept.
Doc. No.
Prepared
Approved
Project name
Based on
Customer
Cust. Doc. No.
Date
Page 6 - Speed Ref
Firmware ver = 7.31
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1


SPEED FEEDBACK
5
(1)
TLP4 250 µsec
1.01 SPEED ACT
22.01 SPEED FB SEL
22.02 SPEED ACT FTIME
22.03 MOTOR GEAR MUL
22.04 MOTOR GEAR DIV
22.05 ZERO SPEED LIMIT
22.06 ZERO SPEED DELAY
22.07 ABOVE SPEED LIM
22.08 SPEED TRIMMARGIN
Estimated
3.000 ms
1
1
30.00 rpm
0 ms
0 rpm
500.0 rpm
SPEED ERROR
6
(2)
TLP4 250 µsec
3.05 SPEEDREF USED
3.06 SPEED ERROR FILT
3.07 ACC COMP TORQ
26.01 SPEED ACT NCTRL
26.02 SPEED REF NCTRL
26.03 SPEED REF PCTRL
26.04 SPEED FEED PCTRL
26.05 SPEED STEP
26.06 SPEED ERR FTIME
26.07 SPEED WINDOW
26.08 ACC COMP DERTIME
26.09 ACC COMP FTIME
SPEED ACT
(7 / 3.01)
SPEEDREF RAMPED
(6 / 3.04)
SPEED REF POS
(11 / 4.01)
SPEEDREF FWD
(11 / 4.20)
0.00 rpm
0 ms
100 rpm
0.05 s
8.0 ms
SPEED CONTROL
7
(3)
TLP4 250 µsec
3.08 TORQ REF SP CTRL
28.01 SPEED ERR NCTRL
28.02 PROPORT GAIN
28.03 INTEGRATION TIME
28.04 DERIVATION TIME
28.05 DERIV FILT TIME
28.06 ACC COMPENSATION
28.07 DROOPING RATE
28.08 BAL REFERENCE
28.09 SPEEDCTRL BAL EN
28.10 MIN TORQ SP CTRL
28.11 MAX TORQ SP CTRL
SPEED ERROR FILT
(7 / 3.06)
10.00
0.50 s
0.000 s
8.0 ms
ACC COMP TORQ
(7 / 3.07)
0.00 %
0.0 %
FALSE
-300.0 %
300.0 %
Page 7 Speed Ctrl
Firmware ver = 1.21
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10003, ver = 1.1
Based on
Customer
Cust.Doc.No.
Date
Prepared
Approved
Projectname
Title
Doc. des.
Resp. dept.
Doc.No.


TORQ REF SEL
1
(1)
TLP1 500 µsec
3.09 TORQ REF1
3.12 TORQUE REF ADD
32.01 TORQ REF1 SEL
32.02 TORQ REF ADD SEL
[A12]
[ZERO]
TORQ REF MOD
2
(2)
TLP1 500 µsec
3.10 TORQ REF RAMPED
3.11 TORQ REF RUSHLIM
< 32.03 TORQ REF IN
32.04 MAXIMUM TORQ REF
32.05 MINIMUM TORQ REF
32.06 LOAD SHARE
32.07 TORQ RAMP UP
32.08 TORQ RAMP DOWN
TORQ REF1
(7 / 3.09)
[30.0 %]
[-3000.0 %]
[1.000]
[0.000 s]
[0.000 s]
REFERENCE CTRL
29
(16)
TLP 2 msec
3.13 TORQ REF TO TC
6.12 OP MODE ACK
< 34.01 EXT1/EXT2 SEL
< 34.02 EXT1 MODE 1/2SEL
34.03 EXT1 CTRL MODE1
34.04 EXT1 CTRL MODE2
34.05 EXT2 CTRL MODE1
34.07 LOCAL CTRL MODE
< 34.08 TREF SPEED SRC
< 34.09 TREF TORQ SRC
< 34.10 TORQ REF ADD SRC
[DI STATUS 1]
(2 / 2.01.D12)
[DI STATUS 5]
(2 / 2.01.D16)
[Speed]
[Homing]
[Positive]
[Speed]
TORQ REF SP CTRL
(7 / 3.08)
TORQ REF RUSHLIM
(8 / 3.11)
TORQUE REF A DD
(8 / 3.12)
Page: 8 - TorqueRef
Firmware ver = 2.3
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Cust. Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. obs.
Resp. dept.
Doc. No.
ABB


ENCODER
15
TUF7 2 msec
(2)
1.08 ENCODER 1 SPEED
1.09 ENCODER 1 POS
1.10 ENCODER 2 SPEED
1.11 ENCODER 2 POS
2.16 FEN DI STATUS
90.01 ENCODER 1 SEL
90.02 ENCODER 2 SEL
90.03 EMUL MODE SEL
90.04 TTL ECHO SEL
90.05 ENC CABLE FAULT
90.10 ENC PAR REFRESH
93.21 EMUL PULSE NR
[None]
[None]
[Disabled]
[Disabled]
[Fault]
[Done]
[0]
RESOLVER CONF
40
TUF7 2 msec
(27)
92.01 RESOLV POLEPAIRS
92.02 EXC SIGNAL AMPL
92.03 EXC SIGNAL FREQ
[1]
[4.0 Vrms]
[1 kHz]
ABSOL ENC CONF
42
TUF7 2 msec
(29)
91.01 SINE COSINE NR
91.02 ABS ENC INTERF
91.03 REV COUNT BITS
91.04 POS DATA BITS
91.05 REFMARK ENA
91.10 HIPERFACE PARITY
91.11 HIPERF BAUDRATE
91.12 HIPERF NODE ADDR
91.20 SSI CLOCK CYCLES
91.21 SSI POSITION MSB
91.22 SSI REVOL MSB
91.23 SSI DATA FORMAT
91.24 SSI BAUD RATE
91.25 SSI MODE
91.26 SSI TRANSMIT CYC
91.27 SSI ZERO PHASE
91.30 ENDAT MODE
91.31 ENDAT MAX CALC
[0]
[None]
[0]
[0]
[FALSE]
[Odd]
[9600]
[64]
[2]
[1]
[1]
[binary]
[100 kbit/s]
[Initial pos.]
[180 dB]
[315-45 deg]
[Initial pos.]
[50 ms]
PULSE ENC CONF
43
TUF7 2 msec
(30)
93.01 ENC1 PULSE NR
93.02 ENC1 TYPE
93.03 ENC1 SP CALCMODE
93.04 ENC1 POS EST ENA
93.05 ENC1 SP EST ENA
93.06 ENC1 OSC LIM
93.11 ENC2 PULSE NR
93.12 ENC2 TYPE
93.13 ENC2 SP CALCMODE
93.14 ENC2 POS EST ENA
93.15 ENC2 SP EST ENA
93.16 ENC2 OSC LIM
[0]
[Quadrature]
[as to rising]
[TRUE]
[FALSE]
[4880Hz]
[0]
[Quadrature]
[as rising]
[TRUE]
[FALSE]
[4880Hz]
Page: 12 Encoder
Firmware ver = 1.2.1
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Cust. Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. des.
Resp. dept.
Doc. No.


MOTOR CONTROL
31
(18)
TLFF 2.msac
3.16 FLUX REF USED
40.01 FLUX REF
40.02 SF REF
40.03 SLIP GAIN
40.04 VOLTAGE RESERVE
40.06 FORCE OPEN LOOP
[100 %]
[4 kHz]
[100 %]
[0 %]
[FALSE]
Page 13 - Motor Ctrl
Firmware ver = 2.1
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Cust. Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. des.
Resp. dept.
Doc. No.
ABB


FAULT FUNCTIONS
33
TLF7 2 msec
(20)
8.01 ACTIVE FAULT
8.02 LAST FAULT
8.03 FAULT TIME HI
8.04 FAULT TIME LO
8.05 ALARM WORD 1
8.06 ALARM WORD 2
8.07 ALARM WORD 3
< 46.01 EXTERNAL FAULT
46.02 SPEED REF SAFE
46.03 LOCAL CTRL LOSS
46.04 MOT PHASE LOSS
46.05 EARTH FAULT
46.06 SUPPL PHS LOSS
46.07 STO DIAGNOSTIC
46.08 CROSS CONNECTION
TRUE
0 rpm
Fault
Fault
Fault
Fault
Fault
Fault
MOT THERM PROT
32
TLF7 2 msec
(19)
1.17 MOTOR TEMP
1.18 MOTOR TEMP EST
45.01 MOT TEMP PROT
45.02 MOT TEMP SOURCE
45.03 MOT TEMP ALM LIM
45.04 MOT TEMP FLT LIM
45.05 AMBIENT TEMP
45.06 MOT LOAD CURVE
45.07 ZERO SPEED LOAD
45.08 BREAK POINT
45.09 MOTNOMTEMPRISE
45.10 MOT THERM TIME
No
ESTIMATED
90 C
110 C
20 C
100 %
100 %
45.00 Hz
80 C
256 s
LIMITS
27
TLF7 2 msec
(14)
20.01 MAXIMUM SPEED
20.02 MINIMUM SPEED
< 20.03 POS SPEED ENA
< 20.04 NEG SPEED ENA
20.05 MAXIMUM CURRENT
20.06 MAXIMUM TORQUE
20.07 MINIMUM TORQUE
1500 rpm
-1500 rpm
TRUE
TRUE
0.00 A
300.0 %
-300.0 %
Page: 14 Protections
Firmware ver = 1.21
Firmware Library ID = 1, ver = 1.0
Standard Library ID = 10000, ver = 1.1
Based on
Customer
Cust. Doc. No.
Date
Prepared
Approved
Project name
Title
Doc. des.
Resp. dept.
Doc. No.

3AFE68848261 REV D / EN
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